AN INVESTIGATION into the THEORETICAL and PRACTICAL ASPECTS of OFFICE MECHANISATION

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"There can be no economy where there is no efficiency".

Disraeli.

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CHAPTER I.

General Considerations in Office Mechanisation.

> "I understand office mechanisation to mean the installation of labour-serving, not necessarily labour-saving machinery , with the object of producing as speedily as possible the necessary information required by those in charge of a modern business".
> J. F. McCartney, Lever Bros., London.

ntroductory.

The problem of mechanisation as applied to office routine is one of comparatively modern origin, at least so far as this country is concerned. Several reasons may be adduced for British conservatism in this matter. There is, for example, the absence of a decimal system. It will be realised that a uniform method of units mounting up to tens and tens to hundreds throughout a system of money, weights and measures, more readily lends itself to the production of mechanical counters geared to give a constant ratio equally applicable to all forms of calculation.

Again, there has been no marked shortage of office labour sufficiently skilled and educated to cope with the ever-growing demands of trade and industry. Indeed, owing to the social standing attached to clerical work, the contrary has been the general rule. Notwithstanding the so called Industrial Revolution which occupied a period sufficiently /

sufficiently long for considerable adjustments in the qualifications of personnel, the clerical side of trade and industry has itself progressed gradually on traditional lines, with an accompanying expansion of population trained to accept orthodox principles of business management. Incidentally, it appears reasonable to assume that the problem of finding adequate clerical labour in the future may become one difficult of satisfactory solution (Appendix 1).

Further, there is an inherent conservatism in the make-up of the British race which appears to be more marked in long established successful businesses than in the newer industries with their more modern forms of organisation. The assimilation of new ideas is often difficult, particularly where their introduction involves a radical change in outlook towards well established principles. The inordinate success which attended British trade and industry since the Industrial Revolution, may perhaps have clouded our vision to possibilities in the reduction of administrative costs. War - particularly economic war - may have her victories no less renowned than peace and plenty. The belated opportunities of professional accountants to embrace the modern technique may also have retarded the growth of office mechanisation to some degree, but a marked change is already noticeable in the growing pressure on /

on these wise men of figures.

The absence of effective competition, particularly in those spheres of economic activity in which we have for long occupied a position of supremacy (cf. banking, insurance, central and local government, etc.) certainly appears to have been a factor in the tardy mechanisation of office routine connected with these large-scale concerns. It is not, therefore, surprising that the field of office mechanisation has not so far been extensively explored with a view to the elucidation of principles which should govern this important sphere of economic activity. It would be unjust, however, to infer that nothing has been done in regard to office machinery itself. Indeed, there are many excellent publications dealing with the scope and the applications of machinery, as the bibliography appended to this thesis will shew (Appendix No.), but it may be emphasised that the object of this investigation is to bring out the main considerations involved in the right relationships between office mechanisation and routine clerical work as but one aspect of applied economics, and to do so by a process of reflection on the basic functions of organisation as modified by the developments in division of labour.

he Industrial REvolution.

It may be useful at this stage to consider briefly the broader problem of mechanisation as applied to industry from /

from the time of the Industrial Revolution, and to analyse the momentous economic changes which that development effected, not only in the structure and organisation of industry, but also in the training and outlook of the workers - changes which have coloured the economic life of almost the whole of western civilization, and which are now in the course of affecting other quarters of the globe.

It is not to be expected that any such extensive social effects can be anticipated from a gradual process of mechanisation applied to office work, because that affects but a minor proportion of the employed populace (Appendix No. 2). Notwithstanding its limited social influence, office mechanisation has had, and is having, important effects on the structure and organisation of trade and industry which may, in some respects, be regarded sequelae of the earlier industrial revolution.

Its general causes.

The main reasons given by Knowles (Industrial and Commercial Revolutions) for the development of mechanisation first of all in Britain, were that this country had a command of capital, a scarcity of workers, large and expanding markets to which there was free access, free population, political security, and some experience in large scale business. The more immediate impulse came from the earlier development of coal and iron. These factors affected various industries with different intensities. For example, the scarcity of hands and the increasing demand for cotton goods /

goods called for machinery which the coal and iron industries could supply, provided the inventive genius was forthcoming. Necessity, it is said, is the mother of invention, and so it proved to be in this case. The stimulation of invention is the insistent demand for it. The alteration in the structure and organisation of industry on a "factory" basis followed as a natural consequence. The economic and social effects of these fundamental changes in the system of production are well known and need not be elaborated here. There are, however, certain aspects of the change which are of particular interest to our especial problem as suggestive of economic changes which we may expect from the progress of office mechanisation. Such, for example were the changed relations of capital and labour, market conditions, the eventual better regulation of hours and conditions of labour, the greater efficiency of production, loss of independence, standardisation of processes and monotony of labour operations.

Its analogies and contrasts with the narrower problem.

We may further examine these latter aspects of mechanisation in industry to see how far they are applicable to the narrower problem.

(a) Labour and capital.

There has been no lack of capital in this country for the modest demands of office mechanisation, but it must be observed that the more advanced types of office machinery are expensive initially and are economically practicable only /

only for large scale operations. A handicap is thus placed on the small business, and "factories" in the sphere of office operations have undoubted advantages. On the part of labour it cannot be said that there is any marked deficiency in the adaptability of the "workers" to utilise mechanical devices effectively, nor is there any marked aversion in the more educated minds to their use. The absence of any scarcity in the numbers of "hands" capable of, and available for, the normal office occupations is, however, in distinct contrast to the conditions prevailing in industry at the beginning of the 19th century. In view of the growing demand for office workers (Appendix No. 2), the notice taken in recent years of the prospective shortage of population in the younger age groups, and the future preponderance of older and less adaptable people seems to indicate that increased attention must be given to the problem of utilising economically the smaller numbers of young people.

Appendix No. 1 shews the age distribution of the population of Scotland during the last four census periods, and extracts from population remarks are given. Appendix No. 2 shews the numbers and percentage of population in Scotland engaged in office occupations during the last four census periods.

(b) Markets and expansion.

It has already been observed that the large and expanding markets of the 19th century made the proposition of increased production through mechanisation an economic one, and that the free access to these markets made an advance in this direction an extremely attractive one. How far can the same /

same be said to be true regarding office mechanisation of the 20th century? It is recognised as one of the elementary principles of mechanisation that large scale operations are essential before a proposition involving considerable capital outlay is economically justifiable. While some stages in office mechanisation do not involve an inordinate outlay, nevertheless larger schemes to which some consideration will later be given do entail significant outlay which could only be borne by large concerns. When it is realised that a normal ledger posting machine costs as much, and sometimes considerably more than two 12 horse-power motor cars, it will be agreed that some concentration of administrative work is in many cases a condition precedent to its adoption.

) Artificial ircumstances ave themelves reated a arket

In this connection the trend of 20th century business administration is significant. The development of a technique in business administration involving accountancy, costing, statistics and governmental returns in relation to central and local government, marketing schemes, etc., to say nothing of the progressive growth in the size of the business unit which in itself usually brings with it a more than proportionate growth in clerical work, has created a market for routine clerical operations, the extent of which has by no means been fully measured.

The concentration of administrative functions in large scale /

scale units is more or less a product of modern times, and may be regarded as a feature of rationalisation - that rather vague principle with which we have become familiar since the Great War, and which has developed its scope due to advances in transport and communications. The earnest endeavour to regain our position in world markets, the almost feverish anxiety to recover some of the losses in an economic sphere already subjected to some rude shocks, has created a questioning attitude towards administrative problems. The enormous growth in the ratio of oncosts to total costs has rendered necessary an increased attention to clerical operations. The sales of office machinery during recent years reflect the results of such examinations into the conduct of office work. As a possible means of relieving pressure and of improving the competitive level of British trade, the office machine has an important place.

Appendix No. 3 indicates the impetus which mechanisation has gained in recent years.

d) Natural circumstances have prevailed in newer countries.

In those countries (cf. America) where extensive markets were more pronounced, where a relative shortage of labour was more marked, and where the force of traditionalism was fundamentally weaker, progress in office mechanisation (aided /

(aided by a decimal system) was much easier. Nothing succeeds like success, and it is natural that the emulation of American methods should receive increasing attention here.

It has been said that everything is the product of a cause (Aristotle). It would appear that office mechanisation is but the result of those multifarious influences which affect that most complex of social organisms, economic activity. The object of this thesis is not, however, to deal with causes so much as to analyse the main economic aspects, and in the subsequent pages to examine the results and consider their effects. By such an approach many difficulties as to the origins of office mechanisation may be avoided. As will be realised, its growth is but the development of a process emerging from small and insignificant beginnings, its technique the accumulation of the experience.

ours and conditions of labour.

The marked tendency of the 20th century towards a progressive reduction in working hours of all classes of the community has acted as an incentive towards office mechanisation. Despite the enormous expansion of clerical operations consequent on regulation both national and local, as well as by particular industrial organisations, the pressure of maintaining the relative status of office workers has necessitated the development and adoption of machinery to undertake voluminous clerical operations. One need only recall /

recall the ineffectiveness of mediaeval taxation in contrast to the present methods of central and local governments to appreciate that better organisation implies better machinery if office working hours are to be kept within reasonable limits. It is a matter of common knowledge that the most highly mechanised offices are, with rare exceptions, those in which the shorter working hours are the rule.

fficiency of production.

As regards efficiency of production, this is a matter which will be dealt with more fully later. Suffice it to say here that the urge for mechanisation is essentially an economic one - the least wasteful production of essential records. It will be the purpose of much which follows to indicate how far office machinery has enabled this object to be achieved.

ss of ndependence.

The loss of independence on the part of the early craftsmen, a characteristic feature of the industrial revolution, finds no counterpart in the development of office mechanisation. While the introduction of office machinery must of necessity cause some disturbance to personnel unsuited to the new methods, the process of its introduction has been gradual and the preparations carefully made. The numbers affected usually represent but a fraction of the office staffs, and absorption of the displaced individuals /

individuals has not caused undue difficulty. As regards future recruitment, however, the long time changes brought about have meant a great reduction in the ratio of male to female clerical staffs. (Appendix No. 4).

Standardisation of processes.

As mechanisation of office process can best be achieved in respect of repetitive work, much has and can be done to reduce operations to a standard form. But to a very much greater extent the problem of each individual firm has been to collect into one place and at the same time the essentially similar operations formerly intermingled with other different transactions. The most marked development has been the standardisation throughout an industry, and throughout different industries, of operations such as ledger posting, addressing, invoicing, etc., hitherto regarded as different and peculiar to a particular business.

Monotony.

The aggregation of similar operations with the express object of providing machinery to undertake them naturally draws attention to the monotony contingent in repetitive work, and further detailed attention will be given to this aspect later. It may, however, be of interest to quote from the South Kensington Science Museum publication on the History and Development of Typewriters:-

"The true function of all classes of machinery is to let the machine take upon itself the bulk of human drudgery in order that mankind may have leisure and freedom in which to /

> to develop a beauty and happiness in life never experienced by the toiling masses of earlier civilisations. When we have learnt to use the gift of the machine in our social development, and to look upon it less as an implement of competition than as an instrument of plenteous production, coupled with a more rational distribution of its products amongst the nations, we shall be in a fair way to the realisation of such an ideal."

he idea of continuity.

While we are apt to regard the Industrial Revolution as having taken place between 1760 to 1830, it is well nigh impossible to date any considerable change in organisation. Organisation is a process not a result, and ideas continue unobserved to work their way through varying stages towards a perfection which seems forever to elude realisation. So also in the problem of office mechanisation, no attempt need be made to date the various significant changes which have characterised the movement. Apart from any historical references, attention will be confined to the present century, for the reason that, prior to this period, the progress made was confined to such processes as typewriting, and, to a lesser degree, to calculating.

auses and effects are but links in a chain.

The concentration of industry brought about by the Industrial Revolution not only facilitated office mechanisation, but in fact came ultimately to demand it, and this demand has come to be expressed through a concentration of function leading to the automatisation of repetitive clerical operations. The extended supply of commodities /

commodities made possible by the improved industrial processes made an extended market imperative, and this extended market has in time necessitated improvements in business administration. The growth in the size of the business unit, although primarily determined by the extent of the market, is to some degree limited by the effectiveness of its nervous centre. So, physiologically, office mechanisation is but a part of the chain of circumstances in economic progress.

conomic science accepts the idea of continuity as fundamental.

In all economic questions the idea of continuity should be ever present in our minds. In the theory of economics, the continuous interaction of demand and supply is so cardinal a fact that it is difficult to visualise any social problem where ~~consideration of~~ the principles affecting these forces do not call for some consideration. From a practical study of office machinery and its applications, the decision as to whether stress should be laid on demand or on supply is extremely difficult to form. Machines are supplied because there is an assumed effective demand for them, but on the other hand supply has awakened demand, quantitatively and qualitatively in quite a remarkable way. Users may and do demand of the machines uses which were never in the minds of the suppliers. Again, effective demand preceding supply sometimes produces machinery capable of doing more than was ever contemplated by those requiring it /

it. There are inherent dangers in this very interaction of demand and supply. Within the limits of philosophical thought, marginal utility is a reasonably definite conception, but its significance must be appreciated in the office if statistics, the production of which is facilitated by office machinery, are merely produced because they are easy of production. In other words, the true efficiency expert does not confine his attention to the most efficient method of producing certain results, but first examines the need for everything. Other things being equal, "doing without" is efficiency par excellence.

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f machines.

This idea of continuity is well illustrated by the development of the various types of office machines. The first arithmetic machine on record was made by Pascal in 1641 and this was followed some thirty years later by Leibnitz's multiplying machine which achieved its function by successive additions and was completed in 1694. The essence of history is, however, its continuity, and it is perhaps inequitable to refer only to the birth of a machine without giving some thought to its earlier conception. We know, for example, that very many centuries before this, Abacus (China) designed a device on the ball-frame principle for adding, subtracting and extracting square and cubic roots. The calculating machines by Thomas de Colmer, 1820, known as arithmometers, achieved some measure of success. Charles /

Charles Babbage, an English inventor (circa 1820), managed to persuade the Government that his ideas for an automatic calculating machine were well worthy of development, and succeeded in inducing the Government to give him financial support to the tune of £20,000. His invention was never finished, and now lies in South Kensington Museum. Incidentally, Babbage had ideas of using perforations in cards for arithmetical purposes, but nothing really came of the idea until 1870 when Professor Herman Hollerith, then a clerk in the United States Census Bureau, introduced the perforated card for compiling the result of the census. About the last quarter of the 19th century, the progress of invention was, however, accelerated. In 1877 Edison invented the phonograph from which the modern dictating machine has been evolved. There is some divergence of opinion as to when the first practical typewriter was produced, but it was probably between 1870 and 1880. It was not till 1900 that the first addressing machine made its appearance. It is interesting to recall that this invention owed its birth to a clerk who found his weekly task of addressing several hundreds of envelopes boring. About 1910, the first ledger posting machine was conceived, and marked a step in the encroachment of the machine on the sacred preserves of the experienced ledger clerk. Frank S. Barber, U.S.A., and W.T. Odhner (Russia) /

(Russia) may be mentioned. Then we have the growth of effective world-wide organisations such as Burroughs,* the National Cash Register Company, Addressograph Ltd., etc., which have perhaps done more than anything else to promote the technique of functional organisation.

Appendix No. 5 gives extracts from a South Kensington Museum Publication - "The History and Development of Typewriters", as illustrative of the social effects of office machinery as well as of the continuity of development of this relatively modern machine." Appendix No. 6 gives a more detailed history of modern office machinery.

nd means to render their use effective.

As in the case of that almost inseparable pair, "shorthand and typewriting", a parallel development to the actual evolution of the machines themselves has been the growth of organisations specialising in the facilitative sphere of mechanisation. The special importance of this feature will be dealt with later, but it is not without interest to observe the difficulty of isolating the respective influences of supply and demand. It would, for example, be difficult to conceive a machine accounting system without the supply of loose-leaf ledgers. On the other hand, the demand for loose-leaf records of all kinds has been largely dominated by the availability of effective office machinery.

Appendix No. 7 gives a brief summary of the development of a firm of world-wide reputation specialising in such facilitative features of office machinery.

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*William C. Burroughs, an American, 1884, exploited the first commercial calculating machine. In 1885 Felt (Felt & Tarrant) patented his first model adding machine.

ucational rogress.

Reference to any historical development of office mechanisation would not be complete without some attention being directed to the educational aspect. Without the personnel, machines are futile. During this century there has been an enormous awakening to the realisation of the need for training in commercial education. As indicated in Appendix 2, the growth in the numbers employed in office and administrative functions has enormously increased. In their continuous endeavour, not only to keep pace with the progress in business technique, but even to be in advance of it, educational authorities have endeavoured to supply adequately trained and equipped personnel to meet the needs of trade and industry. Controversy arises from time to time as to the respective merits of trained business men as contrasted with those acquiring their knowledge in the hard school of experience. No doubt this controversy will go on as long as mankind is capable of argument, and much can be said on both sides.

The opinion appears to be growing, however, that both sides are perhaps inclined to overstress their own point of view, and that a sound cultural education combined with theoretical study and practical experience can produce, on the whole, the best results. It is noteworthy that British universities have, within comparatively recent years, instituted a degree in commerce, and that in particular, Edinburgh /

Edinburgh University, through the generosity of one of its public spirited patrons, has taken a leading place in instituting a practical laboratory for the education and training of university students in office mechanisation. This step is being watched with very great interest by business and professional men throughout the world. It is also interesting to observe that the Cowles Commission for research in economics, in establishing two research scholarships each of $1,000 a year, stipulate that the successful research Fellows are expected to acquire practical familiarity with various types of computing machinery and its technique (Economic Journal, March 1937).

Appendix No. 8 gives the numbers of students taking commercial education in Scotland ~~during the various years of this century.~~

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The appropriate method of approach to the problem involved in the consideration of the economics of office mechanisation has been somewhat difficult to determine. As, however, the elucidation of principles is the main object here, no deliberate attempt has been made to consider the application of machinery to any particular type of office work, nor has any particular type of machine been specially favoured for exhaustive investigation. "Almost all "students of society are in perfect agreement that any "exclusive concentration upon observation or reason, theory "or /

"or application, is mistaken", states E. F. M. Durbin (Methods of Research, etc., Economic Journal, June 1938). In the belief that the purpose of this study will be best served by the appropriate union of theory and observation, no attempt has been made to divorce these distinct aspects of an essentially single problem, because these aspects have also been separately dealt with elsewhere. (Appendix No. 9 gives a bibliography on such matters). It is also worthy of remark that, despite the growth of office mechanisation during this century, so far as is known, no attempt has been made to merge in a single review the practical and theoretical considerations involved in office mechanisation in order to afford some guiding principles of economic advantage. The indiscriminate scrapping of existing systems which have at least had the merits of producing results, without the reasonable expectation that better and quicker results will be obtained, is not the least of the dangers of office mechanisation. Despite the mathematical conceptions of professional economists based on marginal utility, economic advantage in its truest interpretation is one of the hardest things to assess.

The putting of first things first in mechanisation must always be borne in mind, and, accordingly, before any move is made in this direction, it is necessary to make up our /

our minds what economic advantages we hope for from such a step.

chanisation s not an nd but a eans to an nd.

Mechanisation is a means to an end, and, accordingly, it is far more important to keep in view the end, than to exercise meticulous care on the choice of the means. This does not mean to infer that the means is a matter of indifference, either from the point of view of economic considerations or of the end itself. The association of means and ends is so close that a brief consideration of the requirements of an improved system of office organisation should precede the determination of the means to secure it.

e require- ents of an mproved ystem.

Apart from the particular requirements of a specific trade or even of a particular business, it is possible to catalogue in general terms the requirements of an improved system. It cannot be claimed that such a list will cover every aspect of office efficiency. Again, their order of relative significance will vary with circumstances. But in an economic study concern is mainly with efficiency, and its corollary the elimination of wasteful methods. From this angle the following considerations are suggestive:-

1. The reduction of copying to a minimum, and the effecting of this irreducible minimum in the most suitable way, all essential sequelae being considered.

2. /

2. Reduction of calculations with possibilities of summary results being as effective as details.

3. The early preparation of accounts and statistics, synthetical as well as analytical, for the effective control of all departments.

4. The grafting of an effective system of referencing all transactions, backward to source, and forward to final result.

5. The provision of good financial control meeting with the most exacting requirements of audit.

6. Facilitation in the economic employment of staffs of varying capacities and costs.

7. Elasticity quantitatively and qualitatively.

8. Accuracy.

9. The production of an office organisation in harmony with the technical requirements of the trade, yet simple, economical and effective in use.

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achinery.

From even a cursory examination of these points, it will readily be apparent that many - nay even most of them - can be secured without the introduction of machinery. Provided the necessary care is given to the diagnosis, of any office disorder and to the remedy requiring to be prescribed, the cure should be effected with the minimum disutility. To mechanise or not to mechanise is a question which calls for the utmost consideration and care.

"The success of Taylor's organisation lay in his "attitude of mind when seeking for a solution to his "problems. /

"problems. Instead of making a decision and then hoping "he had made a lucky shot, he first defined the problem, "analysed it into its constituent parts, collected as much "data as possible bearing on the problem, classified and "marshalled his information, and then sought a solution". ("The Accountant", 3rd July 1937). So, in the practical application of the scientific outlook, much can be done by simple means to increase the efficiency of routine clerical work. The writer had occasion to deal with over 100,000 enquiries per year. A constant reference to these enquiries was necessitated, and it was found that a carefully thought out system of serially numbering and grouping these enquiries could give remarkable results. Copies of the original enquiries were made by carbon at the point of origin, and filed 1,000 in a binder. Follow up of enquiries was recorded in a register, 100 to a leaf (50 to a page). The page was ruled nine faint lines and one heavy. Given the number of an enquiry, immediate location was possible. For example -

Serial No. 18427 is in Binder 18
Page 184 of Register
Line 27 of Register, and, being under 50 is looked for on first side of leaf.

It appears reasonable that, without involving any complicated or expensive machinery, a number should be made to serve as efficiently as is possible.

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In seeking an answer to the question whether mechanisation is desirable, there is no substitute for knowledge and understanding and a dispassionate weighing of evidence for and against. The wise administrator will never recommend mechanisation where that is not the appropriate remedy, but a remarkable feature of mechanisation is that it not only fits in with the non-mechanical devices by which the requirements of an improved system may be furthered, but it usually necessitates them as a preliminary preparation.

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The attitude of mind which characterised Taylor in his approach to organisational problems is of no less importance in problems of office mechanisation both from the point of view of the employer and of the employed.

On the employers' side there is a marked trend towards a planned economy. The circumstances of large business practically demand it. In this ordered economic activity the Government of the day is taking a hand directly and by legislative enactments. The Central Electricity Board, the London Passenger Transport Board, Milk, Bacon and Potato Marketing Schemes, etc., are examples which come readily to mind. This trend brings in its wake amalgamations, the elimination of the least effective units, planned statistics and standard accounting as vital factors in the successful operation of such organisations, but the very standardisation

of /

of these operations over an ever diminishing number of specially selected firms still further facilitates the standardisation of modern machinery, often specially adapted to meet the quasi binding forms of accounts. The elimination of the least efficient productive units still further stimulates the creation of the appropriate atmosphere for mechanisation, and machine firms are not slow to appreciate and to anticipate the possible needs of such firms and to adopt intensive methods of salesmanship to strikewhile the iron hand of bureaucracy is hot on the rationalisation of a particular industry. Salesmen have been known to be on the job before the full details of an Act of Parliament (cf. Road Transport Act) have been assimilated by the firms mostly concerned. The vital factors in these governmentally fostered schemes are promptitude and accuracy of statistics in standard form (duplicate and triplicate) and accuracy of unit costs. When such statutory requirements are superimposed on the modern standards of accountancy and audit, it is little wonder that the receptiveness of employers towards the blandishments of super-salesmen should be more pronounced. Indeed, it may well be that office machinery in this country is just beginning to play its great part in the more economic organisation of trade and industry, and, if so, there is need for some guidance in its application.

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It does not, however, follow that there is a universal acceptance on the part of employers of modern machinery. A consideration of the hindrances to its extension will call for attention later, but it may be stated here that a failure to appreciate "function" as contrasted with "process" is perhaps the greatest obstacle. Indeed, a certain measure of "old established" prosperity may have dimmed the eyes of the management to the possibilities of mechanical methods.

The responsibility of management is no light one. Directive ability is one of the things which will always be at a premium. Yet directive ability needs all the help it can command if it is to continue effective. Mankind is very largely in control of physical production through the aid of science and invention. On the other hand, in the field of distribution and exchange there is much confusion of thought and action. Plans there are in plenty, but most of them still lack the data necessary for their fruition. It seems reasonable to assume that office mechanisation can make its contribution in this sphere. Mechanisation tends to create an atmosphere of efficiency of a progressive kind. The office must lead not only with plans, but with the detection of any deviations from them, and with the speedy determination of the causes of these deviations. Mechanisation seems to suggest a solution which is worthy of a trial.

"Even /

"Even those .... find their work expedited by machines which help them to do their work quicker and more accurately than they with pencils and corrugated brows could ever hope to do it.°"

(Callisthenes in "The Times").

(b) Employees to whom security of employment is of supreme importance.

From the employees' point of view the psychological aspect is much more complex, and, on the whole, the more important, because, whereas employers may make up their minds whether or not to mechanise, employees can, to some extent, make or mar a scheme of mechanisation after the issue has been so far determined.

There is that type of employee who sees in the introduction of a machine the threat to his future security of employment. In the Industrial Revolution, this proved to be no imaginary evil, and much hardship ensued. While it would be rash at this early stage to attempt to establish the relationship of cause and effect, it may be noted that (whether because of, or in spite of the introduction of office machinery) Appendix No. 2 shows the considerable growth in the number of clerical workers. The marked growth in the size of the industrial and commercial unit has caused more attention to be directed to overhead or unproductive costs, into which category clerical operations are usually placed. It is in the true interest of the employees that their work should be as effective and /

and as low in cost as to be indispensable. The study heretofore devoted to the reduction of manufacturing costs has had its effects in increasing employment, and the same possibilities lie ahead in the clerical field. Mr W. J. Cameron of the Ford Motor Company, speaking on Machines and Jobs, told a radio audience -

> "It always impresses people to learn that most of the machinery in use is not labour-saving machinery at all. Most of it is labour-serving, or labour creating. It enables man to work at tasks that never would have been attempted otherwise. Since modern machinery appeared, twenty great industries have sprung into existence that never could have existed without machinery .... The question is not man versus machine ..... the question is what hitherto unattainable ends man may reach with the machine."

The introduction of machinery will, to some extent, alter the relative importance of some task, and may indeed eliminate altogether the need for it. At various periods in our industrial and commercial history emphasis has been laid on different factors which appeared the most important at that particular time, and this tendency has brought to the forefront several new elements in administration. At one time it may be accurate time recording, at another it is costing, again it may be the shorter periodicity of rendering accounts, and so on. Whatever the fashion of the time, there has been a progressive growth in the volume of office work now considered as the minimum for normal /

normal efficiency, and machines have stimulated this growth.

nd from whom echanisation emands some eadjustments.

Office mechanisation involves normally more than a mere recasting of an organisation. It usually involves a readjustment of approach, attitude, and, in most cases, of personnel. A distinction should be made between machine operations which are under the control of the worker and those in which the worker has to keep pace with the requirements of the machine. In the former (e.g. calculating and accounting machinery) there is a degree of freedom in the rate of working. In the latter (e.g. addressing machinery) there is less scope for expression of variation in human capacity and desires, the compensations in this case being greater uniformity and simplicity in the operations themselves. Highly repetitive work can, however, induce its own boredom, fatigue and strain, intensified by the demands of the machine. Were it not that such work becomes highly automatic, permitting of a certain neutralising measure of mind wandering, this potential disadvantage of office machinery might become a real one. All individuals differ in capacity, temperament and other personal characteristics, and consequently selection should be made for various tasks according to their suitability.

The conflict between the operative and the machine should be reduced as far as possible by adjusting the speed of /

of the machine, by the introduction of rest pauses at the appropriate times, or by the rearrangement of work and workers to secure the best results.

In the words of Professor Huxley - "The life, the "fortune of every one of us depend upon knowing something "of the rules of a game infinitely more difficult and "complicated than chess." We are all engaged in the difficult game of adapting ourselves to the rapidly changing features of business life, and it behoves us to be as fully equipped as possible to meet the new conditions that are continually arising. However deep may be our respect for the craft system of the Middle Ages, if we cannot stem the tide, we must be prepared to ride on it. Then again there is in all of us the <u>vis inertiae</u> to change our settled habits. On the whole, this may be regarded as an advantage, because there is little purpose in change for change's sake, whereas inertia can usually be overcome, provided advantage can be proved.

adjustments spell hardship for some and opportunity for others.

The incapacity of certain individuals to transfer to other work even when security of employment is assured causes some measure of opposition. The introduction of office machinery almost invariably involves the further introduction of young women, while the diminished employment /

employment for males may well become a matter of social concern, but it must be pointed out that the new opportunities for the design, construction, application and sale of office machinery and its accompanying equipment will, in time, largely redress the adverse employment balance. There is the further consideration that, while machinery may undertake with great advantage the routine clerical operations, the need for the thinking capacity is in no wise diminished, and -

> "Just experience tells in every clime and soil
> That those who think must govern those that toil."

rovided the ears of nployees an be satisfactorily isposed of.

There is also on the part of employees the fear of the monotony of work involved in mechanisation. It is rarely appreciated by employees that the application of machinery will call for a very much higher specialisation and intelligence in devising systems and co-ordinating them to serve all departments through expensive machines.

> "More and more business becomes an affair of
> co-ordinating the work of many departments,
> and the office is coming into its own as
> the director and controller of all the rest."
> (Thos. Dickson).

Further, it is necessary to point out that it is to the essentially repetitive and monotonous tasks that machinery can be applied with best chances of success. If such work can be overtaken with less effort and greater expedition by such methods, the net results must be a decrease /

decrease in the duration of monotony, even though a more intense concentration of it is involved.

echanisation assists control of output.

A fear of speeding up also creates a tendency to oppose the introduction of office mechanisation. Office work has been notoriously difficult to control as regards output, but, inasmuch as similar functions are grouped and aggregated, it becomes much more easy to exercise some comparative control on output. Further, the necessity of maintaining an effective load for the machines involves more consideration being given to the arrangements for keeping the machinery continuously employed, particularly where it is difficult or impossible to regulate output in a well defined and homogeneous unit. The fact that a (machine) pace is set in one department has its effect throughout the organisation.

ceptability f office echanisation epends argely on he organiser.

There is also the psychological aspect of the person responsible for the introduction of machinery.

> "The moment the organiser starts to teach people their jobs, even though they may actually employ him to do so, he is faced with difficulties that may seem insurmountable."
> (H. W. Simpson).

It is of the utmost importance that care in the selection of a responsible official should be made to father the scheme from its inception. Diplomacy and the quality of inspiring co-operation, leadership, patience and perseverance, and faith in the installation, are necessary attributes. But he must have capacity for getting to know /

know the practical features of the business and secure the adequate support of his superiors. An analytical mind to discern functions from the mechanical standpoint, good imagination and constructive reasoning ability with some measure of experience will go far in ensuring success in the initial stages. While it is difficult to analyse the make-up of the ideal organiser, it is useful to have his qualities before us. He will require to have:-

(a) Concentration - in order to focus his attention on one thing at a time however small the detail.

(b) Reasoning ability - in order to draw conclusions as to ultimate effects.

(c) Interest in the job on hand and in the outlook and opinions of those who are to work the scheme.

(d) Judgment in the selection of individuals for their most appropriate tasks.

(e) Energy to work unsparingly in the study of the problem and in the eliminating of the difficulties during the "running in" period.

(f) Initiative in adapting machines to work and work to machines, in incorporating the best features of existing practice and in undertaking experiments without guidance.

(g) Imagination to see similarity of function in complex or divers office operations and to conjure up new applications of a labour-saving process.

(h) Attention to the slightest deviation from the preconceived plan.

(i) /

(i) Loyalty to the trust imposed in him to see the job through.

(j) Memory to retain and reproduce impressions.

(k) Enthusiasm to inspire those whom he is guiding.

(l) Ambition to make an unqualified success of the scheme.

(m) Comprehension of all facilitative aspects of mechanisation and of improvements in organisation.

The introduction of office machinery almost always involves some change in organisation, and it is rarely sufficient to study mechanisation only. The fundamental principles of organisation and accountancy must be in the bones of the organiser.

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There is also a psychological moment to suggest the introduction of machinery. This may occur through a variety of incident, or through a multiplicity of circumstances. It may be, for example, that some serious defalcation has occurred which has upset the normal sense of security. Or again a complete overhaul of the existing system may be under contemplation. An amalgamation of offices may be in process of being carried out which materially improves the prospect of economic application of costly machinery. Again, the impending retiral of an ultra conservative official may afford the unique opportunity to redistribute duties so as to bring together operations /

operations in sufficient bulk to justify machine methods. Whatever may be the especial attractiveness of the opportune moment, it is generally advisable to be able to show good cause why such a step should be taken then as contrasted with any other time, as any dislocation consequential on the change over will be less likely to irritate if it would have arisen to some extent in any case, through such a concomitant change.

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nsiderations.

There are various other aspects of mechanisation which are not without importance. The approach to any problem of office organisation involves a comprehensive view of the present and probable future activity of the business. A complete view should embrace critical considerations of need for performing certain operations. The method by which these operations may best be performed, the order of their performance, and the form of presentation of the final result are of secondary importance. A comprehensive view must also take into account the relation of every function to every other, and to the organisation as a whole. The reactions of the present staffs, and the probabilities of obtaining, in the future, staff adequate in numbers and suitably trained, must also be weighed up.

echanisation
implies
precision.

The specific and precise operation of machines
involves, or demands
inhibits precise thinking on the part of the organiser.

Clear /

Clear cut methods and definite plans can take the place of blurred general designs. A change of outlook is always a difficult thing to trace, but it appears true to say that mechanised systems promote logical thinking, and this thinking is perforce applied with greatest results to the employment of the appropriate type of operators for expensive machinery, itself selectively chosen, because the very specialisation implied by the machine enables the predominant psychological requirements to be isolated and looked for in the recruitment of staff. It will be realised that ~~under hand methods~~ for non-mechanical clerical work, it is a much more difficult matter to select clerks according to very well defined aptitudes.

: flexi- ility hould not e lost ight of.

In having at least one eye on the future, there is a difficulty which may be very material. There is always some measure of inflexibility about a machine - particularly one which is specially designed or selected for a job. Variation in the size of the form which can be used may be restricted within certain limits. Beyond these limits the job must be made to suit the machine. Certain columns which are non-additive can only be done in this way according to the build of the machine, although the "set up" may be varied within limits. Precise spacing must be adhered to throughout various groups of operations, position of certain details on address plates must be adhered to throughout an entire /

entire system, or at least a series of plates, if cut out pads are to be operated. Many such examples might be quoted.

If at some future date an important alteration is under contemplation, all these restrictive features fall to be considered so that there must be on the staff of any large undertaking, someone who is able to bring into harmony with the mechanical limits of the installation, the varying departmental notions or desires. In other words, mechanisation enforces, by its very inflexibility, the consideration at all times of the greatest good. Where a costly plant has been installed, financial considerations may give a very forceful meaning to the motto, "Whatever is, is best."

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These points are mentioned because they have a marked effect on the tardy mechanisation of office routine. The leaders of industry are so often leaders because of their distaste for regulation and orthodox methods. They are often reluctant to be restricted in their activities by static requirements of a mechanised system. It may, however, be observed that, with the rapid strides in the development of machinery itself, the makers are very willing to make favourable trade-out conditions in order that users may take advantage of the most recent improvements. It may well be that, owing to improvements,

ten /

ten years might be regarded as the period of most useful life for the more expensive office machinery, by which time the initial cost should have been fully saved to the user.

The question of installing mechanical aid in the office is largely an economic one, and must be determined by the need of such aids, and in the return which they are likely to yield. Needs, on the one hand, are essentially relative, and cannot be assessed by simple standards. On the other hand, returns are difficult to translate into £.s.d. where speed, accuracy, security, and even prestige, may be involved. It will be the purpose of the pages which follow to endeavour to afford some guidance on these issues.

CHAPTER II.

The Planning for Office Mechanisation.

> "Scientific management is not something that can be bought in a box. It is not something in the nature of a drug that one takes and feels better."
> (Morris Llewellyn Cooke).

[In]troductory. Notwithstanding this negation, the determination of the need of machinery in an office requires a careful diagnosis. Its ultimate introduction usually necessitates the most careful planning. Both the diagnosis and planning present some difficulties. The principles of good management cannot be laid down for universal acceptance; indeed less is known comparatively of management than of any other sphere of business activity: it does not readily lend itself to refined tabulation: it has no well defined technique: it must be judged mainly by results. So also must any diagnosis be guided by the symptoms of inefficiency real or imaginary, and by the circumstances under which business is being carried on. Symptoms may take a great variety of forms. It may be, for example, that the ratio of overhead costs to total costs is abnormally high, or that service to the customer is inadequate or too slow. Again, it may be that inaccuracy is the prevailing /

prevailing defect or that the human relations within the organisation itself are continually strained and that personnel is continuously changing. The possibilities are infinite, from feverish energy to smug self-complacency, from wastefulness to penury, from misdirection of energy to the complete absence of a goal. Again, the circumstances under which business activity is conducted may themselves be dynamic by hour, day or season, or have a local character rarely found elsewhere. It would in such circumstances, be foolish to generalise. Yet, if we are to determine whether we are conducting our business economically or merely seizing opportunities as they present themselves, it is necessary to have regard to some standard of accepted practice which accords more or less with satisfactory results elsewhere and is in harmony with the conditions of the times and with the economic responsibilities of management both to the community at large and to the industry in particular. These responsibilities may be taken to be the securing of success with the greatest margin of safety for the longest possible time. In order that some such result may be obtained, care must be exercised over expenditure, and particularly over unremunerative expenditure, and likewise over income particularly as to its prompt and accurate collection and disposal.

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> "Industry has always had a suspicion of the clerk. To the factory worker he is always something of a parasite, to the administrator something of an inevitable nuisance. Clinging to the skirts of management yet shackled with the bonds of labour, the routine clerk is neglected by both."
> (Oliver Sheldon, "Philosophy of Management").

The author of the "Philosophy of Management" has made a rough estimate that in industries engaged in the production of small articles, such as food, 10 per cent. of the personnel are engaged on clerical work, while in concerns manufacturing large goods, the percentage of clerical labour is from 4 to 6 per cent., and concludes that we cannot afford to disregard this feature in industry. (App.31). When we have regard to the more recent developments in public administration, both central and local, and the various public utility and marketing concerns, the significance of clerical work becomes the more pronounced. Were it possible to estimate the amount of work performed in distribution which in a proper functional organism should be performed as clerical labour, it would not be surprising if 20 per cent. were found to be nearer the mark. What is true, however, is that the more scientific the management, the larger bulks the clerical work. The increasing development of mass production, standardisation, comparison by costing, statistics, records and charts, the complexity of wage calculations involving insurance, superannuation etc. /

etc. deductions, is a sufficient indication of the present trend. There is already overcrowding in the counting house, and the selection and training of clerks is intimately connected with the economies of the office. There are, however, other factors in the economics of the office, and one of the most important is the selection of proper tools with which these clerical operations are carried out. It is with this subject we are mainly concerned. But even before an examination of the tools can be attempted, it is well to look at clerical work with a critical eye. Much of it involves the repetition, day after day, week after week, month after month, and even year after year, of the names of the same customers, ratepayers, tenants, consumers, members, subscribers, policy-holders; the repetition of the names of the same employees, the same shareholders, the same depositors or the repetition of similar calculations, and postings. A century of concentration on the mechanisation of production has tended to draw attention away from clerical work which for long had been regarded as being much more individualistic in character, and to obscure the fundamental sameness of recording and of certain mental processes.

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Under the earlier regime of medical science, the function of the practitioner has been mainly directed towards the cure of disease. A new orientation towards a /

a policy of prevention rather than cure is a welcome sign of the times. In the past the tendency also has been to overhaul the existing machinery of administration only when the symptoms of something being radically wrong were painfully evident. The growth of scientific management has, however, focussed attention on the policy of deliberately seeking out the best methods of performing all sorts of tasks. The more complex and exacting conditions of business to-day have stimulated this search which is the more likely to yield economic results with the improved educational standards in business and the growth in the size of the unit. A diagnosis must necessarily have regard to the past history of the case, the present symptoms, and the desirable standards of normal health, before the treatment can be prescribed. This is precisely the nature of the problem of office mechanisation, - a searching all along the line to reveal conditions which do not conform to some principle, and, having found them, to make them conform to what may in the light of all circumstances be regarded as best.

udy of past conditions nd future rends.

To the adviser of office mechanisation the study of past conditions and trend of an industry and of a particular business in that industry is not an academic exercise. The need for an understanding of the historical perspective and /

and of the essential continuity of progress was never greater than it is to-day. It is a necessary pre-requisite of "knowing the idea" underlying the best type of organisation for a business and of knowing the best type of tools to achieve that end.

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The mastery of the features of a particular office is not an easy thing to acquire. We must, for example, at the very outset endeavour to get to grips with certain aspects of the clerical activity as a whole, particularly regarding -

(a) The cost of the present methods as contrasted with alternative methods.

(b) The essentialness or otherwise of performing certain tasks. It is only worth while tasks that should be mechanised.

(c) Similarity of functions and the possibility of their grouping for specialisation and co-ordination, both as regards head office and branches.

(d) The peak loads and the possibilities of evening out such peaks, with particular regard to any time limits presented by the circumstances of the work.

(e) The elasticity of the organisation to permit of practical modifications in existing practice.

(f) The need for improving particular aspects of the activities which have given indications of stress.

(g) The disintegrating forces mitigating against a harmonious working of the organisation as a whole, e.g. as between head office and branches.

(h) /

(h) The economics of effective control involving problems of interpretation of statistics.

(i) The degree of precision of the present method as contrasted with the significance of improved accuracy.

(j) The adaptability of staff and period of training necessary.

(k) The degree of standardisation possible.

(l) The onus on the office to provide the means for the best management by telling the whole truth (in sufficiently analysed form) and to foster the conditions under which progress and expansion is possible.

It has also to be borne in mind that in clerical work where intimate knowledge is so often an important prerequisite of performance, division of labour can readily be carried beyond the stage at which the cost of picking up the threads may far outweigh the advantages of specific output. On these grounds a subjective rather than an objective analysis is essential. Mental processes are infinite in their variety, and should be experienced by the individual who proposes to organise them.

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How may a plan best be prepared? Inasmuch as machinery is designed to perform certain operations of a repetitive kind, it is necessary as a basis to adopt some broad form of classification of clerical work. This classification may take various forms according to the nature of the business. For example, a classification which /

which suggests itself is -

(a) Financial - the keeping of books of accounts and costing records.

(b) Statistical - the maintenance of records of sales, production, staff, etc.

(c) Interpretative - the translation of customers' requirements into forms suited to the internal organisation, and the translation of the statistical records into trends, etc.

(d) Liaison - the keeping in touch with customers, suppliers, workpeople and management with a view to lubricating the machinery of organisation.

(C.B. Frisby - Industrial Psychology applied to the Office).

While it may have been true that office mechanisation was intensively concerned with (a) and (b) in its earlier stages, it may equally be true to say to-day that there is no sphere of office activity to which mechanisation may not contribute. Devices for the interpretation of statistics (c) have reached a very high state of efficiency, (See Chapter V on Punched Card Art) and mechanised means of communication with departments (d) and with the outside world are now commonplace.

Where the application of machinery to office work is under consideration, the classification of clerical work requires much more finesse. It involves the splitting up of classifications into what may better be labelled "operation" which may represent but a fraction of classification /

classification. An analysis suggested in "The Accountant" (April 1938) is:-

(1) Preparing processes,
(2) Sorting,
(3) Listing,
(4) Tabulating,
(5) Adding and calculating,
(6) Posting,
(7) Checking.

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A much more detailed analysis is suggested by the headings under which the machines themselves may be catalogued. It may, however, be pointed out that the ever growing specialisation in the manufacture of machines themselves will necessitate a revision of such a classification. -

Book-keeping and accounting, cheque writing,
  costing, wage records.
Invoicing (+ advice)
Analysis
Typewriting (+ adding, analysis, duplicating,
  invoicing, book-keeping, protecting)
Adding (+ typewriting)
Listing
Calculating
Cash registration (+ receipting)
Recording (photographic)
Cash handling (+ recording, analysis)
Cheque signing (+ protecting)
Coin sorting and counting (+ notes, coupons)
Dictating and recording
Copying, manifolding
Filing (+ visibility, signalling, numbering)
Letter opening, sealing franking
Ticket issuing (+ recording)
Ticket writing
Time recording
Communications (telephone, delivery systems)
Addressing, listing and selection
Folding
Printing
Fastening
Stock keeping

Such /

Such a list cannot be regarded as exhaustive in any way, but it affords a basis for considering the scope of possible mechanisation.

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There are noticeable in office mechanisation two distinct tendencies which may be referred to here. First of all there is the tendency towards the further subdivision of operation and the presentation of a highly specialised machine to perform that operation uncommonly well. Secondly, there is the opposite tendency to group a series of operations on one complex machine which can perform simultaneously several operations which are in invariable and logical sequence or association. The economics of office mechanisation involve the very careful study of the relative advantages in time saving, accuracy, and general facilitative organisation to ascertain whether subdivision or combination of operations will yield the best results, having regard to the volume of work involved. It appears that, inasmuch as mass production principles can never be applied to office work to the same extent as to production itself, and in view of the number of small businesses which continue to survive (See Appendix No.10), the future of office mechanisation will depend to a considerable extent on the facility of machinery to cope with the separation or the grouping of allied operations. It may here be noticed /

noticed that, within comparatively recent years (cf. the motor manufacturing industry) marked progress has been made in production in the development of simultaneous and consecutive operations being carried out on a composite machine embodying the patented principles of many incremental advances. There is much to be said for the further amalgamation of office machinery firms in order that progress may be made along the lines of incorporating in a few general purposes machines, the present best features of several.

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Divisions and sub-divisions are rarely adequate or watertight, yet they also afford a useful guide if the principle of division of labour is to be applied in any economic sense. The advantages of division of labour are too well known to require recapitulation, but it may be emphasised that, particularly in clerical work, it is seldom known how much, say, calculating work is carried on in a large office until it has been brought together in one place, or how many of staff and how much of the equipment represents a standby for peak periods. The aggregation of similar operations and the pooling of resources to deal with them makes possible a reduction in margins with consequent gains in economy. When this aggregation of similar functions has been completed and the /

the cyclical variation of their incidence has been studied, it is a relatively easy matter to determine, in conjunction with ascertained machine capacities, what peak loads require to be provided for. By readjustment it is very often possible to flatten out machine loads and thereby reduce capital outlay to reasonable dimensions.

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It has been said that "power of co-ordination is the "limiting factor in the growth of businesses"*, and if this were true in 1923 when it was written, it is much more important now, notwithstanding the considerable advances made in the interval by improved communications and the speeding up of recording in its varying forms. Departmentalism, an essential of big business, may at the same time be the arch-enemy of co-ordination if control is weak, and the office must ever be the handmaiden of control.

Departmentalism is itself a broad form of division of labour, but it may require drastic revision if a co-ordinated and comprehensive plan of office mechanisation on strictly functional lines is to replace a well embedded departmentalism founded on industrial process. The tendency for departments to regard themselves as self-contained units often breeds a spirit inimical to effective co-operation. The function of office machinery, however, is generally to serve the organisation as a whole. Accordingly in /

*The Philosophy of Management - Oliver Sheldon.

in his plans for the introduction of office machinery the organiser must pay particular attention to the means for effecting co-ordination. This may materially influence the location of the machinery section and its layout, the stage at which "operation" will be separated from "function" and the degree and intensity to which the mechanisation itself may safely be carried into practice. It may indeed create the need for a new function - that of "liaison", if harmony is to be ensured.

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Having considered the nature and volume of work for which machinery is possible, and for which concentration is practicable in the light of co-operative effort, it may then be possible to determine whether in any particular case there are any considerations which might operate against the realisation of any resulting economies, and whether such economies are likely to afford a decisive margin in favour of mechanisation. The following further points may then be taken into account:-

(a) Order of priority in which mechanisation should be undertaken.

(b) Intensity - hand machines, electrical, and degree of automaticity desirable.

(c) Practical combination of operations, e.g. by duplicating.

(d) Most suitable type of machinery available.

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rticularised tudy f every etail is ssential

So far we have been concerned only with the broad question as to whether there are, prima facie, grounds for a detailed investigation into the economics of mechanisation, and whether a sound plan of organisation consistent with the activity of the business can be suggested.

The particular problem will involve its own details. A few examples may be cited as indicative of the nature of these details. (Appendix 11 gives a fuller example of the points involved in a scheme for mechanisation of local rates).

(a) Invoicing.

Number of invoices per day, week and month, and standardisation possible.

Number of copies required and any variability in number, e.g. customers who require in duplicate.

Amount of descriptive detail required or codification possibilities (see codification.

Average number of lines.

Whether copying only, or copying, calculating and addition is involved.

Whether this operation stands alone or is combined with other operations (say addressing, advice notes, ledger posting, etc.)

Presence or absence of peak loads.

Possibility of conjoining facilitative devices (continuous stationery - partly printed details, etc., sets of forms - self adjusting carbons).

Use /

Use to which invoices can be put in the internal organisation.

(b) Ledger posting.

Whether narrative is necessary or embodied in ledger heading.

Number of postings, cross references, etc.

Whether self-balancing, involving pick up and new balance.

Degree of audit proof of accuracy.

Other records involved.

Whether entries are mixed - debtor and creditor.

Number of postings in a run.

Whether calculating is involved.

Possibility of conjoining facilitative devices.

Classification of income and expenditure under well defined headings standardised throughout all departments.

(c) Wages.

Form of recording of "time".

Number of employees.

Records involved - e.g. pay sheet, wage envelope, superannuation and income tax records.

Number of additions and deductions.

Variations in rates of pay.

Time /

Time available for preparation.

Proof of accuracy.

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On the other hand, the machines themselves call for an equally detailed consideration with regard to such points as:-

(a) Capabilities for the work to be mechanised.

(b) Capacity for loads.

(c) Ease of handling and operation and learning.

(d) Speed, performance, visibility.

(e) Value of by-products, such as additive, selective, reproductive, storage features.

(f) Degree of automaticity - carriage return, dating.

(g) Cost and cost of running and maintenance.

(h) Possibilities of "service" in the event of breakdowns.

(i) Accuracy and proof facilities.

(j) Flexibility and alternative uses.

(k) Silence.

(l) Probable "life".

(m) Cost of amending organisation.

(n) Degree of simultaneity possible.

(o) Opinions of users.

(p) Accessibility of "set-up".

The emphasis to be laid on any particular feature will depend /

depend on the nature of the work, but, as in other issues where considerations are in conflict, the lesser must give way to the more important.

rogramme develop- it can evolved.

After an unbiassed survey of the whole field of mechanisation, it is desirable, even at this early stage, to have a plan for its development, and this might take the following form:-

(1) Make general decisions as to the amount of re-organisation necessary in all departments with order of priority; on such matters as the degree to which "operations" will be detached and aggregated for all departments and the extent to which machinery pools can effectively function; and on the degree to which readjustments can be made to secure uniformity in the preparation and presentation of mechanised results.

(2) Settle on the type of system best suited to the business as a whole. Here again the greatest good must be the overriding consideration. Even assuming that each department has already arrived at its optimum efficiency, an impaired efficiency in one department may be more than compensated for by an overall gain. Such questions as to the respective merits of a combined addressing and accounting plant, a punched card system or more specialised fractional mechanisation should be answered if progress is to be made.

(3) Fix a date, reasonably well in advance, when the change in system is to take effect, having regard to the -

(a) quietest time in the activity of the undertaking;

(b) probable date for delivery of machines;

(c) /

(c) time involved in drawing up the necessary forms;
(d) impending changes in staff, etc.

(4) Prepare a detailed plan, preferably in diagrammatic form, showing the organisation as a whole (See Appendix 12).

(5) Draw up a detailed specification of every stage in every operation including a sample of every form and record to be used.

(6) Specify all proofs of accuracy, audit, and control, and the correlation of such records as cost and financial accounts.

(7) Give the utmost care to the consideration of all facilitative aspects of the working of the scheme in the light of the limitations of the machines, e.g. size of forms, order of columns, spacing of lines, filing.

(8) Design a system of codification to minimise unnecessary copying work but consistent with ready interpretation.

(9) Consider planning of office and arrangement of machines for streamline production.

(10) Wherever possible, superimpose additional controls advantageous to the business which may hitherto have been impossible - e.g. maximum and minimum stocks, signals for credit balances, automatic serial numbers.

(11) Ensure adequate cross-referencing.

(12) Consider whether peaks can be flattened out in the course of re-organisation in the light of estimated machine performance.

(13) Plan the placing of staff according to their aptitudes in the scheme of mechanisation.

(14) Estimate output at the various stages in the scheme in accordance with machine performance.

(15) Estimate the annual savings of the mechanised system over present methods.

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It does not follow that all of these matters will call for consideration every time a machine is introduced. For example, the application of a Brandt Automatic Cashier in the process of making up wages is merely the substitution of a mechanical handling of money for a manual one. Little No change in the system as it stands is involved. But the point to be emphasised is that attention to details has important effects:-

(1) The working out of such details is a safeguard for a comprehensive understanding of the business, and for carefully thought out plans making provision for normal difficulties. Any defects in the plans are more likely to be brought to light before any serious issues arise.

(2) The evidence of the consideration of such detail inspires confidence and understanding in the minds of the management and of the staff.

(3) Detailed development of the scheme in advance is an invaluable help as a basis on which to build the better final structure of a system after some experience has been gained.

(4) An opportunity is afforded to all concerned to criticise and to contribute their ideas to the scheme before it is too late. In particular the meshing into the existing organisation may be studied from the plan.

It is rarely sufficient merely to diagnose a disease and prescribe a treatment. The patient must be induced to take the medicine, and he can best be induced by putting it into a palatable and easily digested form. If it is necessary /

necessary to administer the treatment under an anaesthetic, this sometimes simplifies matters, but usually there must be some measure of prior consent. Converts are, in general, better than conscripts.

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sirable.

Having studied working conditions and prepared plans shewing the best way of doing everything necessary at the best time, the next stage is that of testing and comparison.

The nature of the test depends on circumstances, but several methods suggest themselves:-

(a) Put a limited number of past transactions through the modelled system.

(b) Put a small section of the current work through the system.

(c) Compare the proposed system with that being operated on mechanised lines elsewhere.

(d) Allow the suppliers of the favoured machines free access to the existing records to make their own investigations. In this way useful suggestions are usually forthcoming.

In practice it is often possible to employ all these methods or a combination of some of them.

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quitable.

In carrying out and judging of the results of such a test, certain precautions are necessary:-

(1) It is always necessary to concentrate on main issues. At the test stage there will always be initial difficulties which may be capable of elimination under a fully working scheme.

(2) /

(2) There is always a temptation to carry out a test with specially selected items. If the onus of selection is on the part of the seller of the machine, simple transactions may be selected. On the other hand, the buyer tends to concentrate on the difficult and complicated cases, thereby upsetting many equitable conclusions as to time involved. It is therefore desirable that an endeavour should be made either to weight according to their normal incidence the normal and the difficult, or to make a representative selection.

(3) The test may be carried out -
(a) by the suppliers' specially skilled operators
(b) by the untrained and prejudiced employees of the buyer.

Allowances must be made according to the case.

(4) The facilitative conditions of the test will, in all probability be defective at this stage, e.g. suitable forms, logical arrangement, etc.

(5) Standards of comparison may be defective or entirely wanting. The time and real costs of former hand methods are rarely obtainable, particularly when regard is had to errors in reading of manuscript compared with machine records, amount of checking subsequently involved and now eliminated, the added value of proof of accuracy, and so on.

(6) Codification, often a prerequisite of effective mechanisation (see later) is rarely ready at this stage.

Indeed, one has often to be content <u>rebus sic stantibus</u> and form a considered opinion. A test is rarely wholly satisfactory, but it affords considerable opportunity for forming reasonably reliable conclusions as to the ultimate effectiveness /

effectiveness or otherwise of the proposed scheme, and for effecting adjustments on theoretical conceptions. Further, where there are competitive alternatives, the same test, defective as it may be, can be applied to each, and the comparative results so obtained are sufficiently reliable. With the modern methods of science available to vendors of office machinery, the future holds great possibilities for the inexpensive yet effective demonstration of the applications of such machines to repetitive office work, and the day may not be far distant when films showing the complete cycle of operations, and the features of control and audit will be realistically presented to prospects in a way less disturbing to office organisation than the present methods of trial.

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sessed.

After a test or tests have been carried out, it is necessary to have some formula by which the merits of the various systems may be evaluated. It is difficult to generalise on formulae, because of their specific nature and intent, but experience will suggest factors of significance.

Appendix No.11 gives a formula of evaluation applied in a particular case.

In this comparison, the value to be assigned to particular points will vary from case to case. Some may be a matter of opinion or even sentiment, but others will be of paramount consideration. In addition, the peculiar considerations /

considerations applicable to certain subsidiary applications may be of such a rare occurrence that notice need not be taken of them in the general survey.

Accordingly, it is desirable to classify the points in the evaluation of a system into three broad classifications:-

(a) Indispensable features
(b) Desirable features
(c) Incidental advantages.

Only those schemes which qualify under (a) should be further investigated.

ification often an onomy.

Expense must always be a consideration in the economic application of office machinery, and in this term is embraced, not only the initial capital cost of the machine, but all the incidentals of forms, equipment and working costs in relation to output. The scope and flexibility of modern machinery has been remarkably improved within recent years, and, while it is now possible to secure a high degree of complex operation on one machine, the user must, in his own interest, endeavour to secure the optimum results from a given expenditure of time and money. This may often be secured by the adjustments made in the nature of the feeding of the machine, such as documents for handling, cycle of operations, etc. Many of these aids in efficient operation will be dealt with later, but /

but, as the possibilities of codification will determine the precise nature of the machinery to be installed, it must be considered in the early stages of the introduction of office machines.

By codification is meant the utilisation of short term references to represent longer descriptive appellations. Codification may be simple or complex, and the determination of a system appropriate to the circumstances will depend partly on the uses, apart from mere mechanisation, to which this codification can be put, and on the inherent advantages to be secured from a logical codification which is easy to memorise and interpret.

Appendix No. 13 gives a codification of Gas Department Stores designed ~~by the author~~ for a machine accounting system. This was based on a pre-existing classification of stores according to the natural requirements of the Department, and has proved helpful in many directions apart from mechanisation.

The main objects of codification may be said to be economic in that -

(a) It saves time and labour in referring to long descriptions.

(b) It is precise, unambiguous and minimises error.

(c) Its adoption widens the scope of utilising cheaper but equally effective machinery on routine operations (e.g. extensive keyboard not necessary).

(d) /

(d) It facilitates rapid sorting as a preliminary to posting.

(e) If properly done, it permits of extensions for new items (flexibility).

(f) It is applicable to many spheres of clerical work, e.g. stores, jobbing, financial accounts, etc.
(Appendix No.   shews a codification for a Gasworks Cost Accounts).

(g) It should permit of decoding without constant reference to code books.

(h) It greatly reduces machine operations.

When a system of codification (usually inspired or at least hastened by an impending mechanisation of records) is under contemplation, it is desirable that its designer should be ~~au fait~~ thoroughly conversant with all the ramifications of the business apart from the mere mechanical requirements. It is a relatively simple matter to meet the needs of a particular machine. It is a very much more difficult matter to adjust codification to the best interests of the business. On the other hand it is usually a simple matter to have a machine, otherwise suitable, adjusted to operate an ideal codification system at the time of its purchase, but it is a difficult matter later on. Discussion of the ideal system should precede the mechanisation, not follow it.

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odification.

As already indicated, various methods may be applied to a system of codification. There is the system of continuous coding, i.e. applying a serial number to each item /

item, leaving adequate blanks for additions from time to time. This involves a careful estimation of possible additions if a rational arrangement is to be maintained. Again, there is the method of ~~broad~~ classification to ensure that each ~~broad~~ group is homogeneous according to

)lex
lification.

the practice of the trade. Lastly there is the more complex codification which expresses broad classification, plus position in the sectional series and size of item, e.g. -

A Cast iron (goods)
106 Brackets right angle
F 6"

A106.F.

The determination of the most appropriate system is a matter of expediency and experience.

use
forms.

Analagous to the determination of a coding system as a prerequisite to mechanisation is the consideration of a system of forms. Machinery in its operation is essentially precise, and the positioning of every entry according to the relatively fixed "set up" involves the planning of forms to afford the best results. The economic application of machinery to office work depends to a much greater degree than is generally recognised, on the careful design of forms, their size, shape and arrangement. It is true to say that a change in mental outlook is here involved, and preconceived ideas of natural order must give way /

way to the logic of mechanisation if the best results are to be achieved. Where machinery is involved, in the preparation of form it is important to consider the continuity and cyclical nature of machine operation. It is only too common to find blanks requiring to be filled in at various points in a form necessitating spacing along and up the form when a discreet rearrangement could ensure that all matter to be inserted is collected at the most convenient machine spot. Such an adjustment considerably improves output.

For example, if the incidence of credit items were to be five times as frequent as debit entries, it would be an advantage to have the credit column preceding the debit, although this may be contrary to the usual practice. A prolonged study of mechanised systems has revealed that much of the reluctance to adopt mechanised methods is due to the prejudice for the status quo. Other things being equal, there is much to be said for established practice, but, inasmuch as mechanisation is only justified on economic grounds, the spirit of enquiry should not be hampered in an endeavour to increase mechanical marginal utility. Standardisation, of which the printed form is the embodiment is usually based on the best practice, and as such should be determined and utilised on all appropriate occasions /

occasions as an aid to efficient operation and correct interpretation. Standardisation of forms also provides a means of economy in printing costs and storage space.

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require
ision.

There are cases where mechanisation involves only an isolated operation or group of operations such as the franking of letters, the recording of time, or the duplicating of reports. In such cases the problem of control is simple and specific. A complete system of mechanisation involving a regrouping of function and operation, however, may upset the former system of control by the management. Here, the advocate of mechanisation must give very careful consideration to the establishment of control points for all the activities of the office. By control in this sense is meant the provision of the management with assurances at various key positions that -

(a) Duplication of effort has been minimised.

(b) That accuracy, according to predetermined standards is being secured (qualitative).

(c) Performance according to economic standards is being maintained (quantitative).

(d) Operative delegation is offset by managerial responsibility.

(e) A common goal is being appropriately emphasised rather than a departmental desire.

(f) The clear cut instructions designed for the maximum advantage are being carried out.

(g) /

(g) The facts ascertained through mechanisation are being used to influence decisions.

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rformance
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udied.

Apart from problems of organisation and control, in the evolution of a mechanised system one of the most important factors - usually of more importance than initial cost - is performance. Of all the principles on which mechanisation prospers, the aggregation of a mass of similar operations or groups of similar operations as units of performance gives the best results and facilitates the control of output. Indeed, before the machine is introduced, the makers will usually give some indication of performance in the work for which the machine is being recommended. Experience proves that this indication is usually a very modest one which is soon surpassed after a few weeks' working. In order, however, that control of performance may be equitable, it is found essential to standardise working conditions and then to ensure homogeneity of the unit of measurement. This involves the study of the operations and the job, the use of standard forms, codified descriptions, and so on - a species of facilitative organisation which will invariably yield valuable results whether for mechanised purposes or not.

The safe rules for standard performance as laid down by/

by Knoeppel are:-

(1) Where there are no pronounced variations in readings of time study (corrected for avoidable delays) a fair standard may be determined by adding one-half the difference between best and average times to the best times.

(2) Where there are pronounced variations drop readings above average and, using the balance, add one-half the difference between best and average times to the best time.

It is possible to develop reasonable standards of performance and to record the results in such a manner that weak points may be strengthened in time to be of real service. Often it is desirable to adjust the design of the machine, to modify the organisation or method or correct defects in personnel, or to reconsider co-ordination throughout departments. A barometer recording last week's air pressure is of little service for a weather forecast, but a speedometer is an effective instrument continuously recording present speed. Any standard determined should, however, be such that one can attain it on the average, and for reasonable periods, without injury to body or mind.

:hod of resentation s useful to anagement.

After the fullest investigation into the merits of and need for mechanisation, the method of presentation of the scheme as a whole before those whom it is desirable to influence will call for some consideration. In view of the pressure on the time of the management, and their limited knowledge of the detailed considerations involved /

involved in mechanisation, the principle of realistic presentation should be considered. The complexity of modern problems and the need for planning and combining related activities makes this method appropriate. Realistic presentation involves patient and unbiassed research, the proper marks and virtues of scientific enquiry. The attempt at diagrammatic presentation of administrative problems tends to promote coherent thought, and to bring us to a more realistic conception of affairs which in everyday business life may be of more immediate importance than philosophic principles. Office mechanisation is not a policy; it is a technique founded on experience, and as such should lend itself to a presentation in a comprehensible and incisive technical drawing or illustration.

As being
mprehensive.

Organisation as an agent of production has found its place in economic science. The combination and co-ordination of operations may be of no less importance than the operations themselves and it is generally desirable that this combination and co-ordination should be presented within the compass of a single view, otherwise it is doubtful whether their significance will be fully realised. The utilitarian aspect of the diagrammatic presentation of office mechanisation rests on the capacity of a diagram to make available to the management the comprehensive knowledge which it may be impossible for those ultimately responsible for decisions to acquire by personal experience.

Criticism /

Challenging.

Criticism, which challenges yet strengthens, is more compelling where it is just, more precise where it is enlightened, more readily disarmed where it is erring, and is more likely to be plied with discrimination when applied to an organisation founded on, and fashioned into, a well conceived design.

Writing of custom, the late Professor Marshall said -

> "It has rendered the supreme service of perpetuating any such change as has found general approval, it has supplied a permanent body of general designs on which each fresh mind might try to make some variation for the sake of economy of effort, of increased utility and more pleasing effect."

A governing body is subject to changes in personnel. An administration to be effective must be permitted to be strong and have some degree of stability and permanency. It need not, and should not, be "frozen". The instrument of public action for common ends must be appreciated and understood. A plan of a complete scheme has that required degree of stability and permanency, while at the same time it affords a perpetual invitation for improvement. To the Executive Officer this invitation is indispensable. His knowledge is of a more intimate nature, his experience a more valuable asset, and he, as a rule, is peculiarly adapted to add those finishing touches to a plan which will enhance the working efficiency of his particular department.

) Precise.

While attention may, on occasion, be confined to a single aspect of department, an understanding and realisation of the function /

function of this aspect in relation to the whole is best understood from a diagram, while a wider responsibility is engendered by a plan indicating the co-ordination of part with whole.

Emphasis can readily be given to the scope and method of departmental activities in a Diagrammatic Presentation. Continuity of construction and development and combination with other spheres is more likely to be assured when the organisation, which should never be entirely at the mercy of every mind, has been brought out and presented in such a way.

and co-
linative.

Apart from the considerations of complexity, the grow; ing size of the administrative unit necessarily involves considerable devolution of routine functions on junior officials, who, in the absence of full knowledge, may be apt to introduce anomalies which may tend to detract from the merits of the main objective. Furthermore, the local autonomy which engenders and keeps alive the first-hand interest in maintaining that objective is apt to be impaired by that very growth in size, which so often makes for good government by facilitating uniformity and equality of treatment of the various problems over wide areas. Where such intimate association is weakened, it is all the more incumbent on a modern administration that suitable means be provided whereby each clearly distinguishable function in a complex. /

complex business may be divided into a compact group of associated activities branching off yet co-ordinated at various centres in logical sequence and so as to facilitate effective supervision and control. While it is often difficult, and indeed sometimes impossible, to recognise dividing lines in the various activities, nevertheless the analysis and synthesis involved in Diagrammatic Presentation can generally suggest broad outlines or fundamental facts such as preparation, production or distribution, or contributory functions towards any of these ends.

It must be conceded, however, that, while this form of presentation lends itself to the preservation of consistency and rational effort, it can rarely incorporate the dynamic conditions which form the atmosphere under which administration is carried on. Nor can it, of itself, conveniently express the peculiar individual faculties and skill desirable or necessary for the due performance of duties. Edmund Burke aptly said that "Nothing in pro-"gression can rest on its original plan", and from time to time such plan requires revision and amendment in accordance with the changing problem of administration. This necessity for revision does not, however, refute the efficiency of the plan any more than the introduction of an up-to-date machine can be condemned because it does not, of itself /

itself, provide for its periodical inspection, upkeep and repair.

If such a method can attract interest and attention and provoke thought, through its invaluable, expressive and universal language, it may do much to attune the minds of officials to a free interchange of knowledge and experience in this mechanical age, and to accelerate and increase the power of organisation as a real force endowed with imagination and critical faculty.

"Phenomena", said Holland, "grow from many independent "roots and are formed and coloured according to the charac- "ter of the various soils from which they have sprung." In the satisfaction of their needs, mankind have seldom seen clearly the ends at which they were aiming, and have, therefore, in reaching after these ends invented a vast variety of perverse complications.

No man was ever endowed with a judgment so correct and sure but that time, circumstance and further experience could teach him something. It is perhaps unfortunate that a very large part of public administration consists in understanding, unravelling and explaining these perverse complications and in reducing them to a logical basis, but inasmuch as the eye is better trained than the ear and can follow action more unerringly, and can more readily render some unfamiliar object ~~au fait,~~ understandable a diagram with its predilection /

predilection towards clearness of conscious reasoning, orderly arrangement and sharpness of definition, has undoubted utility for such a process.

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However ardently we may search for a new world, we are ultimately compelled to look for its foundations in the debris of the past. Now, as throughout history, we cannot escape from the great evolutionary law of continuity, and it is meet that we should not try to do so, but rather take from the past the best it can offer us in theory and practice. It is true that some problems can only be satisfactorily solved by a method mainly historical, but others such as office mechanisation lend themselves to a shorter one.

Knowledge and skill must each play their part; knowledge, as Socrates observed, is the product of a cause, and skill implies the provision of opportunities for the scientific application of knowledge according to a plan. The plan of attack is not everything to an army, but if it be ill conceived, the results can never be entirely satisfactory. So in organisation, the positive, systematic, efficient and co-ordinated application of available effort must be directed according to a rational plan, if it is to achieve the ends determined by the administration.

much ground-
ork has al-
eady been
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A useful diagram on some practical problem cannot be evolved without much detailed knowledge which the general theory /

theory of administration and organisation cannot profess to give. When the plan has been formed it derives some of its impetus from its enthusiastic designer, but the time arrives when that administrator is divorced from his particular sphere of activity, and it is well that there should be left some scheme on which others may exercise their genius.

The trend of modern business with its mechanical inventions and its scientific wonders will ever call for a coterie of specialists who require to devote their life to the furtherance of their particular investigations or experiments; yet none of the results of their specialisation can be regarded as haphazard, they are one and all the result of accretions of knowledge.

In many businesses, officials know their duties only in a general way; they do not know them with any exactitude. There is a wholesale lack of definition; the administrative practice is a blur, not a design. Science, on the other hand, is correlation of known facts; it is organised truth, and diagrammatic presentation is helping to make what is true into what is known, and diminishes the element of fear founded on mystery.

Science rightly interpreted is imbued with a forward looking mind. It subjects established precedent to dispassionate survey; its impulse is towards a higher and still higher standard, and it insists on method.

By /

By marshalling and arranging facts in the form of an intimate, realistic and attractive diagram, interesting to the intelligence and helpful to the development of team work, may we not look forward with intensification of interest to a proper place being found for diagrammatic presentation, for -

> "Words are like leaves, and where they most abound
> Much fruit of sense beneath is rarely found."

Appendix No. 12 gives an example of the method of presentation here considered.

blems of change er.

There are two schools of thought regarding the method of change over to mechanisation. On the one hand there are those who favour the gradual introduction, according to a preconceived plan, of office machines as part of the scheme of complete mechanisation. On the other, there are those who favour the complete change over as at a specified convenient date. There is the old proverb - "Don't put all your eggs in one basket". There is also the late Mr Andrew Carnegie's amendment - "Put all your eggs in one basket, but watch the basket." The right decision is very largely a matter of policy and confidence in the scheme. It is seriously suggested that, in the absence of any special circumstances, a complete change over should be made ~~as~~ at a convenient date, but only in relation to a prescribed section (functional) at a time, after /

after a careful cultivation of the territory. Such mechanisation need not necessarily be the final form aimed at. This view has been formed after a very careful study of such comparative failures as have been made public in recent times.

The reasons adduced for this procedure are as follows:-

(1) Partial mechanisation can lead to endless confusion and resulting economies may be long delayed.

(2) Partial mechanisation presupposes a lack of confidence in the scheme introduced, and this is fatal to its success.

(3) Total mechanisation of all sections at one time creates too great a demand, on the staff whose outlook cannot be changed as from a specific date. Moreover, the nursing of each section can be better carried out where a dissipation of attention is not involved.

(4) Mechanisation of all sections creates too great a strain on the supervisor, as many unforeseen circumstances are bound to arise during the early stages which no amount of testing beforehand will reveal.

Then again there is the appropriate time to introduce the change. In almost every business there is a period in the cycle of yearly activity when the effecting of any radical change can be done with less inconvenience than at any other time. It is highly desirable to introduce mechanisation with as little disturbance as possible to the normal activity.

It /

It must, however, be emphasised that a complete plan of the whole ultimate development should precede the change over of a well defined section, if final harmony is to be secured. "Initial planning is of the greatest "importance in obtaining the greatest ultimate success" (Economy and Control through Office Method - Workman.)

clusion. Practically every transaction between buyer and seller is based upon either weighing, counting or measuring, and each of these involves figures, names and addresses, and a measure of organisation and fatigue for somebody.

Machinery is available which will weigh, count, measure and furnish selected names and addresses and at the same time perform many other operations with a degree of automaticity hitherto undreamed of. The complete exclusion of economic considerations from office work is hardly conceivable. One is, therefore, forced to the conclusion that every consideration should be given to possibility of handling the routine operations so often involved in office work, by machinery. Caxton, in the preface to his first printed book, wrote -

> "My hand weary and not steadfast, my eyes dimmed with overmuch looking on the white paper."

That weariness has not grown less. It may never entirely disappear, but it behoves us to profit by the scientific advances /

advances for its reduction, as all forms of fatigue is disutility. We need not hope for perfection in mechanisation. Human endeavour rarely results in the ideal achievement. Horizons recede as we move towards them, and, indeed, mechanisation may introduce weariness in new forms. But a much better office, in which the majority of routine operations of a largely mechanical nature are performed more quickly and more accurately by machines, we may certainly hope for. Mechanisation in the office, as elsewhere, can only be applied on an extensive scale where the scale of operation justifies it, and can only be applied economically where the utmost care is given to every aspect and method of its introduction and application. The first consideration may often rule out the smaller business, but even in the larger it may involve some centralisation.

F. W. Taylor, (1895), in presenting his famous paper on functional organisation to the American Society of Mechanical Engineers, advocated the installation of the best available machinery and tools so far as these were compatible with economy, and the determination of appropriate speeds and combinations for the most effective results in the shortest time. The stress he laid on the re-arrangement of equipment, etc., so as to avoid delays and minimise /

minimise unnecessary handling, and the need for study and analysis of detached processes and methods with a view to the elimination of wasted time and effort, are of no less significance in the introduction of office machinery. Nor even at this early date was he unmindful of the importance of keeping records so that information might be readily available on all aspects of production. His contribution to the theory and practice of office mechanisation will always be recognised. He might well be called the "father of functional organisation."

CHAPTER III.

The Effective Operation of Office Machines.

> "By operating efficiency is meant the efficiency of the machine handled as it is actually handled, and employed as it is actually employed, and measured by the quantity or quality of its output set against the time it is at work or the power, material or labour it consumes. It is obvious that when men and machines co-operate in production, it is difficult to measure the efficiency of the man apart from the machine or vice versa."
>
> (Frederick Brown - "The Measurement of Physical Output and of Operating Efficiency).

roductory.

As pointed out by the writer quoted, measurements of efficiency usually take the form of ratios - ratios derived from routine records or special tests. The results obtained from each of these sources may differ as between themselves, and in either case only reveal efficiency under given conditions which are rarely constant. But, having selected work suitable for mechanisation and introduced machines appropriate for such work, the problem of working these machines effectively under conditions subject to variations is one which calls for the continuous vigilance and initiative of the organiser. This may involve among other things the discovery of new applications of the machinery itself or the modification in the procedure connected with the feeding manipulation or arrangement of the /

the processes. The effective use of new methods of control, made possible by the machines, and the facilitative aspects of organisation not connected directly with the machines, may also call for considerable thought and further planning. It may well be that further subdivision of operation will suggest itself as a result of practical experience, involving still further mechanisation, if the fullest economies for the expenditure already incurred are to be realised. The point of emphasis is, however, that even the most careful introduction of machinery is rarely the last word. It is only the beginning of what may prove to be a long and arduous progression. Organisation, as Sheldon so aptly puts it, is a process, not a result, and mechanisation is but a means to an end. Quality is a much more important factor in mechanisation than quantity. By quality is meant not only permanency and reliability but also suitability for the work and for the organisation. It should be recognised that there are types of organisation which practically defy mechanisation (e.g. enquiry departments), because of the difficulties of properly grouping the specific functions involved in the work. There are businesses of such dimensions that large scale mechanisation is unavoidable, but there are small businesses where almost any machinery would be uneconomic. But investigation into the nature of alternative systems of mechanisation will always repay the labour involved, and comparisons of tried /

tried systems of an analogous nature will afford reliable guidance in the matter of suitable arrangements necessary for effective functioning such as the provision of appropriate posting media, the standardisation of stationery, and the ability to cope with variations in the volume of the work. Even where the problems are not strictly comparable, much valuable information can be gleaned in this way if the high costs of exploration are to be avoided. Almost every organiser has his particular mental blind spots and prejudices. A willingness to be criticised by colleagues is a sign, not of weakness, but of strength.

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onditions.

a) Lighting

The physical conditions of the office itself must be conducive to the successful operation of the machines. There is no adequate substitute for good daylight, and this preferably should come from all sides, and where practicable roof lighting, adequately protected from direct glare of sunlight, has much to commend it. Where the ideal conditions do not obtain, much can be done to give a semblance of the ideal. For example, if ceilings and upper walls are made and kept white, a better diffusion of daylight, such as is available, is thus secured. Where, as is perhaps more common, artificial light is necessary, shaded lamps to produce a diffused effect are desirable, and hinged shaded lighting can usually be adopted in particular cases /

cases where adjustments are needed from time to time. The amount of nervous energy unnecessarily expended through defective lighting is perhaps not fully realised. Lighting arrangements are seldom given the care that they deserve. Absence of shadows and the elimination of glare are the main characteristics of effective lighting, but regard should also be had to the finish of the machines themselves. Dull finishes are now being introduced in the newer models of office machines. Even after effective lighting conditions have been secured, care should be exercised to ensure that these are maintained by the periodical dusting of lighting effects and the changing of globes. (Appendix No. 15 gives guidance in this connection.)

) Heating.

Heating must also be carefully studied. An even temperature of about 67°F. is usually recommended. Whereas there is a general tendency towards under lighting, there is just as often a tendency towards over heating in offices, particularly towards the later part of the day. This is due to the time taken in the warming up process, and to the difficulties in regulating the flow of heat to a large building in relation to the various degrees of ventilation and heat conserving characteristics of different rooms, and to daily variations in humidity of atmosphere.

c) Ventilation.

Closely allied to the question of heating, that of ventilation without draughts is also a practical difficulty, the /

the solution of which depends on many factors. The density of occupation, the need for ready accesses, the varying individual sensitiveness to atmospheric conditions which themselves are subject to change, make an ideal standard difficult of attainment; yet the importance of healthy and comfortable conditions for the working life of the staff is very great in the maintenance of good health and efficiency. The idea of air conditioning and of controlled temperature and humidity has been applied so successfully to places of entertainment that we may look for developments in the sphere of economic activity. That the physical state of the office has a great influence on the quality of the work is gradually being realised, while the inventiveness of man in devising automatic controls on atmosphere is rendering practicable the realisation of office conditions more nearly approaching the ideal.

) Noise. The following extract from the Report of the Chief Inspector of Factories (1936) is significant:-

> "There is no evidence that the problem of noise is receiving much consideration in industry, but an instance is quoted where in an office the noisy machines have been isolated by means of double glass partitions. These have the advantage of causing no loss of light and a minimum waste of floor space."

It is needless to refer here to the numerous investigations of scientific societies into the uneconomic effect of noise, particularly where the expenditure of nervous energy is the main characteristic. Relief from noise must be sought by the /

the reduction of sound at its source, namely, the machine.

. In the selection of machines, therefore, attention should be directed to the noise emanating from the operation of various machines, and, other things being equal, preference should always be given to the least noisy. In the more commonplace office machinery some real progress has been made in producing "noiseless" or "silent" machines such as typewriters, but in many electrically operated machines such as postal frankers, typewriters, billing and addressing machines, for example, there is room for much improvement. The progress we have witnessed in the production of the motor car seems to indicate that if the users do but make silence the deciding factor in the purchase of office machinery, much cause for complaint will have disappeared within the next few years. At the present time, some mechanised offices resemble factories. Even in the best organised, there is an undercurrent of sound which differs from the normal office murmur made up of human voices and the rustle of papers. It comes from the ceaseless tapping of a number of electrically driven machines which are carrying out to a surprising extent the calculations hitherto carried out by hand and brain. Mean while, much can be done to minimise the deleterious effects of noise, by the use of non-resounding tables, the use of noise absorbing materials on walls and ceilings /

ceilings, curtains and pelmets. The isolation of such noise as is unavoidable should generally be possible on the lines indicated by the Inspector of Factories, and attention given to the equipment ancillary to the machines themselves.

) Obstruc-
ion to
ovement.

With the extending use of electrically operated office machinery, the problem of wiring up in a way at once flexible and unobstructive is a matter calling for greater attention. At the present time where rapid development in office mechanisation is the rule rather than the exception, a modern office may present a very untidy appearance. Telephone cables, house telephone wires, "flexes" for lighting and cables for calculating and ledger posting machines, folding machines, postal frankers, and adding machines, abound in profusion, creating a real hindrance to the free movement of personnel and equipment. It is true that an office reconstruction may afford opportunities for the better disposition of these wires and cables.

Layout.

The general layout of an office employing machinery is a matter of considerable significance. As the basis of mechanisation is the horizontal grouping of operations, the essentials of a good layout is to permit of an easy directional flow of related operations with the minimum of travel and handling. Except where the object is the isolation of noisy machinery, the absence of partitions will /

will be of assistance, not only in the matter of temperature and ventilation, but also in facilitating supervision and for conserving space. Arrangements should also be made to ensure proximity to the records to be used. The records themselves should be stored vertically rather than horizontally in order to obviate the handling of records which are unwanted at the time of reference. Where contact with the public is a regular matter, the convenience of access should also be borne in mind, and room for possible extension is desirable wherever practicable.

Where a number of machines are housed in one department, adequate space of 3 to 4 feet should be left for the movement of staff along well defined passages. Such generous spacing also has the advantage of limiting conversation between operators, thereby stimulating better concentration on the work on hand.

Particularly when the machines to be installed are heavy in themselves, or involve an amount of heavy auxiliary equipment (e.g. addressing plant with metal plates), the floor stresses should be considered, as the amount and distribution of weight on the floor may in certain circumstances be considerable.

No two problems in layout are entirely similar, but these general principles of so arranging equipment as to permit of effective functioning under the expert supervision /

supervision of the person in charge, are worthy of the closest attention.

Modern office technique and methods are completly changing office requirements from the point of view of architectural features, and the day may not be far distant when the acoustics and finishings of a building can only be effectively completed after the machinery has been selected and installed. The significance of convenient premises is indicated in Appendix No. 24.

Seating d rniture.

The use of a type of chair which will ensure adequate command over the keyboard and operating levers of each machine without causing undue fatigue is now so well recognised by the suppliers of office machinery that many have taken it upon themselves to supply the most suitable adjustable chair as part of the machine. There are several well known makes on the market, but, owing to the differences in individual requirements, a too rigid standardisation may not be universally advisable. For example, owing to other considerations such as limited office space whereby certain equipment for the use of the operator must be placed behind, a swivel chair may under such circumstances be preferable to a fixed one. Further, owing to the size of documents to be handled on particular jobs, a table space much larger than that incorporated in the standard machine is usually advisable. Experience has shown that, in the endeavour to produce a compact machine (e.g. Postal Franker, Burroughs, Moon-Hopkins) /

Moon-Hopkins) the needs of the userhave not always been fully considered. It may, for example, be pointed out that the Electric Universal Postal Franker - a machine excellent in itself - would be a much more usable machine had it been -

(a) adjustable for a sitting posture, and

(b) sunk or built in to give an expansive and flat table surface with a "well" stacking arrangement for automatic bundling of franked letters.

There is much to be said for the standardisation of size, design and finish of the furniture and equipment for use in connection with machines, provided this is based on the studied best methods of operation. The influence of the correct design of furniture on the consistent adoption of best methods of operation cannot be overlooked, but the best design can only be arrived at after taking into consideration the type of loose leaf or card ledgers, etc., used in the operation. A particularly instructive lesson in the special design of furniture and equipment is to be found in the offices of the Fife Electric Company at Dunfermline.

ibility d restric- on of ading tter.

The ready visibility of reading matter from which machines are to be operated is of even more significance than good lighting on the keyboard. The touch system which every operator assimilates to varying degrees, combined /

combined with the regularity of and good marking found in almost all keyboards, considerably reduces keyboard errors. But the reading off of figures and other particulars from documents which are not always prepared with precision as regards figures positioning, description, etc., involves the human element all the time. It is felt that the use of copy holders, line spacers, ready reckoners which will only make visible at one time the information immediately required have not yet been fully appreciated, and a new field for the development of relatively automatic devices in this connection awaits cultivation. (See Chapter VIII.)

The weakness of a table is that -

(a) time is uneconomically utilised in reference and in establishing the correct two dimensions,

(b) it exposes information not required at the time and leads to errors,

(c) eye strain is considerable.

While it may be contended that there are specialised machines capable of doing any reckoning required, much more quickly than any table, it must be appreciated that, where there are long runs of similar calculations (which are usually memorised by operators) with an occasional irregular one, it may not pay to make the calculation a separate operation.

The principle of masking out all information except what is required at the time is well known, so also is that /

that of fly leaf tables to reduce the span of tables, but in view of the infinite variety of reckonings required in office work, this is one of the cases where special devices designed to deal with particularly limited ranges of calculations, in contra distinction to marketed devices for general use, may amply repay the study and labour involved in their construction.

dance of nscription.

While it is desirable to make an original document travel as far as possible in the office routine without a change of form, it is, nevertheless, desirable to feed machines with an easily digestible food. Forms ultimately to be used for translation into machine operations should, as already indicated, be designed to meet the cycle of operations involved. But where other considerations are also involved, much can be done by folding and masking to give the desired results. A further development is the "pegboard" system - a system of so arranging separate forms vertically or horizontally that only the essential information is visible in a readily additive form, thus avoiding much rewriting of detail. The pegboard system thus obviates the need for unnecessary abstracting and at the same time affords a visual "line a time" guide for the eye. The flexibility of this system means that it can be modified at any time according to new conditions and requirements, and for all classes of work. (An illustration is given in Appendix No. 16).

"In /

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staff.

> "In the first place no two persons are born exactly alike, but each differs from each in natural endowments, one being suited for one occupation and another for another".

In the matter of the staff selection we are in perhaps the least scientific field of office mechanisation - not because this is a matter of minor importance, but because the great complexity of behaviour of the adult individual seems to offer "an almost insurmountable barrier to systematisation". Industry, despite its mechanisation and material structure, is made of human stuff. It is still necessary to get to know the people who work the system, and to position them to the best advantage. Mechanisation can best serve to direct human energies into more productive channels by alleviating the drudgery of constant repetition. The business man has yet to be convinced of the reliability of psychological and other tests in the selection of staff.

The essential purpose of vocational guidance is to determine scientifically the abilities of an individual and to relate these to the various occupational requirements. The two dimensions of the problem - occupational analysis and diagnosis of individual abilities and personalities - both have their difficulties and uncertainties, and each requires different kinds of investigation. The complexity of the whole problem is enormous, but its economic importance cannot be overestimated, as the appropriate selection of staff can make or mar office organisation.

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scientific
thods.

The following extracts from the investigations by Dora Bieneman into ability in typewriting under the aegis of the International Labour Office are of interest:-

> "Typewriting as an occupation has increased in importance almost more rapidly than any other in recent times. The typewriter was invented about two hundred years ago, but it only began to come into use about forty or forty-five years ago and even then only in large establishments. To-day typewriting is one of the most important commercial occupations and in fact seems indispensable. Unfortunately the occupation is overcrowded with inefficients; the work seems easy, a matter of habit and practice rather than of special ability. There are far too many youths and even more girls (for typewriting is becoming more and more a woman's occupation), who have no very definite inclination or pronounced capacity and therefore become typists for lack of a better opening, and are confident of success. In this, however, they are mistaken. Typewriting is not a purely manual trade, and in order to succeed and achieve a fairly secure and well paid position the typist needs to be able to do more than strike the keys with two or three fingers. She needs special capacities and vocational abilities, not to mention thorough training."

> "We have a right to affirm that, in general, the superiority of one worker over another, even in wholly mechanical work, is due far more to intellectual than to physical qualities."
> (Prof. Imbert of Montpelier - Anne Psychologique, 1912).

In contrast to the studies of Mlle. Dora Bieneman on the application of the experimental methods to vocational guidance with a view to the securing the most suitable staffs for such office work as typewriting, the motion study in typewriting by J. M. Lahy (International Labour Office, Study J. No. 3) gives some indication of the other aspect of /

of the question, namely, the vocational requirements of a particular office operation. (Appendix No. 17).

From a study of these and other reports on the psychological aspects of the selection of staff, it appears equitable to conclude that -

(a) The determination of simple, yet suitable, tests (apart from intelligence tests) for the detection of individual aptitudes and innate ability have not yet reached that conclusiveness as to be capable of general application by the ordinary business man.

(b) The determination of the vocational requirements of specific operations connected with the manipulation of office machinery has not yet sufficiently advanced as to provide the business man with an entirely reliable formula for the scientific selection of operators.

(c) "The most accurate method of determining the aptitude of an individual for a vocation or activity is the test of life itself. The ultimate test must always be the learning of it, and the degree of the individual's proficiency when he has reached the limit of training".
(Clark L. Hull, Prof. of Psychology, University of Wisconsin).

This is not meant to infer that no good has emerged from such scientific analysis. On the contrary, as pointed out by Professor Hull, the time and energy required to discover an individual's ultimate aptitude by the method of trial is so great that not more than one or two determinations can be made in the course of an ordinary life, and if it turns out that the choice of a vocation is ill advised, there is certain to be a great economic loss to employer /

employer and employed. The magnitude of these losses in the aggregate are probably collossal, and any devices, however imperfect, for determining aptitudes in advance should have their proper place in the selection of office staff, provided the tests are reasonably quick and inexpensive.

We now know the elements in making a typewriting operation such as -

(a) period of depression of keys,
(b) duration of interval between striking keys,
(c) intervals are always shorter between alternating hands,
(d) speed is attainable rather by shortening the interval than by shortening the contact.

We also know that good memory for digits and phrases, sustained attention, firm tactile and muscular sensibility, a tendency to ambidexterity, motor rapidity, in addition to a knowledge of grammar and spelling, and a good general education, are all qualities constant in a good typist. But the conclusion is that the good typist is not necessarily the one who possesses such a group of virtues, but "the one who is most successful in adapting this superior "ability to the combined effort required by the complex "operations of the work of the occupation". (International Labour Office Report, Series J. No. 2). The quest of the business man is concerned only for such an operator. It is generally agreed that efficiency in an occupation may be somewhat different from natural aptitude inasmuch as /

as efficiency is objective and aptitude subjective. The former can be judged by results of a commercial value, while the latter involves the more subtle and probably less reliable psychological tests. Moreover, moral qualities, such as honesty and conscientiousness, ambition, patience and initiative, are sometimes of as vital importance in trade and industry as vocational abilities, and, as yet, there are no tests for these qualities, although it may be granted that employment suited to the capacities of an individual is more likely to stimulate his better qualities, moral, as well as mental and physical.

assisted mechanation.

In the problem of the selection of suitable staff there is this advantage in mechanisation that it is much more possible to enumerate some of the important operational requirements, and to look for the appropriate aptitudes in individuals through the aid of simple tests which, in practice, have proved capable of separating the sheep from the goats, than is practicable where general office work has not been broken up into separate operations. When a probationary period is in force, observation on temperament, character, precision, interest, pride of work and on moral and social qualities can usually supplement observations on the results of training. Employment tests in industry are the practical outcome of industrial mechanisation quite as much /

much as the development of machinery itself. That they have not progressed in the same scientific incremental way is due to the enormous difficulties inherent in the problem, to much spurious work which has been foisted on the public as scientific, and, finally, to lack of precision in the conclusions which may safely be made regarding them. The difficulties of the individual and his reactions, not only to test, but also to the employment and all that this involves in incentive and in general conditions of employment, will probably always endure, but the changes in employment itself have somewhat simplified this aspect. Functionalised and centralised employment, specialisation and mechanisation have brought many operations within the range of test, and efficient selection by qualified investigators at least is supplementary to the traditional method of careful interview, question and general assessment. The importance of having the right man in the right job never was greater, because inefficient production in one department may lead to snowball losses in others.

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For general office work the test must always be that of general intelligence and education, with a bias perhaps to clerical work of the level for which individuals are to be selected. Alertness, memory, willingness, accuracy, are all capable of being graded even if not of scientific measurement, having regard to historical considerations of age /

age, schooling, etc., and afford reasonable starting points for a probationary period of service, although they may be inadequate as predictive of future ability.

More specialised clerical tests for filing and sorting, an important subsidiary function associated with mechanisation, may be introduced to test aptitudes. Those suggested by D. G. Paterson (Journal of Personal Research I, 1923, pp. 547-61) embrace such items as -

(a) alphabetising of names,
(b) classifying of numbers,
(c) comparing of names and numbers to determine whether identical,
(d) classifying of items of information under group headings,
(e) answering of questions on paragraphs to be read,
(f) finding of names or words in directories and dictionaries.

The study of tests for typists has already been referred to (Appendix No. 17). A great variety of tests have been applied with varying success and indications of reliability. These may be summarised -

(1) Attention - Rapidity of observation.
Cancelling letters in a page, finding numbers in a table or noting identity of names.

(2) Memorising - (acquiring associations).
Substituting letters for forms according to a code.

(3) Immediate memory span.
Reproduction of sentences and numbers after looking at them.

(4) Speed of association.
Giving words bearing a certain relation to suggested words.

(5) /

(5) Intelligence
Typical intelligence or alertness tests.

(6) Tactile sensibility.
Discriminating by touch between cards having 2, 3 or 4 holes punched in them.

(7) Motor capacity.
Manual dexterity and speed of finger movement.

(8) Acquired associations.
Spelling and vocal tests.

(9) Typewriting reaction test.
For typewriting ability an individual has to respond to dictated series of numbers, etc., by striking the appropriate keys.

(10) Typewriting rhythm test.
To test ability to strike a series of keys with rhythmic regularity.

(11) Test in speed of tapping.
Striking one key in rapid succession.

Some experimental work has also been done in an endeavour to determine aptitude as comptometer operators (Methods for the Selection of Comptometer Operators, Journal of Applied Psychology, Vol. V, 275-83), for Elliot Fisher book-keeping machine operators (A. W. Kornhauser, A Statistical Study of a Specialised Group of Office Workers, Journal of Personnel Research II, 1923, 103-23), and for Hollerith Machine card punchers (L. Marcus - Vocational Selection for Specialised Tasks, Journal of Applied Psychology, IV, 1920, 186-201), but the results obtained from these tests made on a limited scale cannot be regarded as conclusive. With the introduction of dictaphones /

dictaphones, films, and the development of automatic recording devices, the possibilities of the future for investigations are considerably enhanced. The need is greater and the methods of approach have been experimented with.

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It is sometimes urged, with some measure of apparent reason, that the introduction of modern office machinery has given rise to a soul destroying monotony on the part of the operators.

A detailed investigation into this aspect of office mechanisation scarcely reveals any marked tendency in this direction. We hear little of the clerk of a century ago acquiring grey hairs by wearily adding up columns of figures day by day. This could never be regarded as a particularly colourful existence. It has been found that those on this type of work became so mechanical in their mental operations that they could simultaneously add up figures and think of, and even discuss, other matters.

A machine which does a great deal of this work to-day occupies considerably less time, mental effort and concentration, and leaves the operator free to appreciate the many problems with which the job is usually associated.

Further problems arising in connection with the work, contact of the employees with the managers and supervisors of the business, create a certain measure of mental stimulus. But /

But, apart from these extraneous diversions, it should be borne in mind that few office machines are wholly automatic (cf. book-keeping machines). In all of these a certain amount of mental effort is required. It is true that certain operations (such as card punching) are not very stimulating, but such work is usually performed by young girls who are employed on this work for a comparatively short time, for the simple reason that it is not economic to employ them much above the age of 18, and operators are usually given opportunities of learning other branches of the work. It must also be realised that the machines perform rapidly only that part of the work which unduly fatigues the mental powers because of its monotony and repetition.

A study by S. Wyatt and J. N. Langdon (Medical Research Council, Industrial Health Research Board, 1937) on fatigue and boredom in repetitive work, (Appendix 18) although mainly concerned with routine work of a manipulative nature, makes some helpful observations which seem to confirm the general view that fatigue and boredom in such work is apt to be overstressed, and that the general nature of office work involving a measure of mental stimulus, whether in the actual operation, or in the preparations necessary for the next stage, precludes the opportunity for undue boredom. (Appendix No. 18).

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The individual under mechanisation is not a mere cog in a wheel; he is still a social animal with a social function and an ability to co-operate - a member of a group. The group must be made sufficiently comfortable and interested to endure the machine, which in the majority of cases is specially designed in relation to the operator. It is probably this factor which, subconsciously, influences the undoubted popularity of the machine.

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While the design of the machine must primarily be made according to the mechanical needs, constructional consideration for the operator takes many forms, and it is useful to notice some of these. The scientific arrangement of the typewriter keyboard whereby the keys most in use are allotted to the strongest fingers is now an accepted principle, as is the elimination of the energy to be expended in operation through the substitution of electric for human power, the lightening of "touch", or the incorporation of additional automatic features. The elimination of static fatigue through the maintenance of a set position is not, however, so easy, although, as will be seen later, the introduction of appropriate rest periods offers some solution. In the reduction of keyboard, centralisation of controls, utilisation of natural rhythm of operation for changing forms, etc., the periodical alternation of right and /

and left hands, the elimination of vibration and noise, the modern machine has gone a long way towards minimising fatigue. The realisation that machine and operator is one unit, from the point of view of efficiency, coupled with the fact that "design habits" are not so rigid where tradition has not yet had time to take roots, has enabled the users' point of view to find expression in improvements of detail. Manufacturers are constantly making improvements, partly through the requirements that arise through users and partly through technical research. Therefore, while in many cases the function of the machine may be the same to-day as it was, say, ten years ago, its actual facilities are greatly altered and improved. While the close associations between sellers and users and keen competition of sellers of office machines are the greatest stimuli in the attention given to operating details, the lack of adequate data as to the needs of operators is perhaps the greatest hindrance to further improvements in this connection. A rebel is a blessing now and then. It may be of interest to note that the writer was responsible for the introduction of "negative selection" in addressing machines, now a standard feature of modern plant.

A gradual infiltration of university graduates into office work, and the development of welfare work concerned as much with the well-being of the individual as with the output /

output, may bring about a more scientific orientation towards the operating of office machines efficiently. The machine was made for man, not man for the machine, and in so far as it is possible to make the adjustment in the machine to suit human aptitudes, this should be the first endeavour, but there are limits to the flexibility of the machine, and the next best thing is to select the man and make the best of it. Mechanisation necessitates the general raising of the level of intelligence of the staff. The mute obedience to the machine soon proclaims the foolishness of its master, and consequences of such foolishness may be much more serious than where the output of a single individual is concerned.

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After a selection of suitable staff has been made, there remains the problem of employing this staff effectively.

In certain industrial processes employing machinery, it has been proved that pauses for rest and relaxation have been found to be economical from the point of view of output and advantageous from the subjective point of view of the worker. Generally, these rest intervals are at stated periods. It has also been found possible to introduce diversions by way of music to promote rhythm and mental stimulus in the case of operations which are highly automatic /

automatic after a certain skill has been acquired.

It must, however, be recognised that office work is of an entirely different nature. In the first place the continuance of prolonged runs of exactly the same operation are not by any means the general rule. In the second place, there is not the same scope for the mechanisation and automatisation of the ancillary work connected with mechanisation. The feeding of the machines with appropriate forms is generally required to be done by the operator, the interpretation of documents and their translation to the machine requires the individual intelligence of the operator to a higher degree than, say, a drilling machine guided by a gig and stopped automatically when the correct depth has been reached. Thirdly, even in the best organised office there are delays when an enforced break of an irregular nature occurs. It may be, for example, that a difficulty of interpretation may arise, that papers require rearrangement at frequent intervals, that an ever changing order of priority in work may cause diversions of work. Fourthly, whereas in a power driven machine, it may be practicable to control rest pauses at stated intervals by the stoppage of plant, in an office, the universal cessation of work in a machinery department might upset the smooth running of the business, and would not, moreover, be any guarantee of mental rest to the operators concerned /

concerned. The office worker is also of a different type. Factory workers have more of the herd instinct than office workers. Office assistants are more temperamental: they are often sensitive, highly strung, diffident and shy. It has been found that some of these prefer to remain at their machines rather than retire compulsorily at the sounding of a gong. So frequently has this been found to be the case with women office workers, that it is considered advisable to allow "free movement", and to trust the employees not to take undue advantage. Some women have stated that it "puts them off" their work to stop, and they prefer to carry on, particularly if they are specially interested in the job on hand.

The following opinions of two machinery firms are of interest:-

> "With modern equipment, seating, lighting ventilation, etc., rest periods are no longer essential, although in practice the majority of firms do allow a break in the afternoon for tea (which after all is more an "Institution" than a necessity) while more and more firms nowadays are also allowing a break in the morning. Some users have claimed that the daily output has been improved as a result of instituting break periods, but it is possible that the reason for this is largely psychological."

> "The working of our machines does not impose any unusual strain on the operators, and rest periods are not essential. Nevertheless, we advocate short periodical pauses to relieve the monotony, and in our Embossing Department where we have some 100 or more girls occupied on the embossing of our customers' /

customers' plates we arrange for rest periods of ten minutes every two hours."

It is reasonable to assume that if fatigue exists it will manifest itself in some way, in the falling off of output or in the increase in spoilt work. These manifestations must be watched and a suitable remedy applied. No physician will suggest a remedy until he has studied the symptoms, but, as often as not, the remedy is quite a simple one.

The aids which an operator derives from correct posture and from the optimum positioning of her documents are considerable. Speed in feeding the machine, reduction in fatigue, time saved in looking for documents, are obvious advantages available to all who take the trouble to study motions. Visibility of titles, signalling by tab, colour, size, etc., according to some readily memorisable classification, not only assists in location, but also in the preservation of a predetermined sequence. The introduction of semi-permanent separators should not be overlooked, and the opportunities for the use of continuous stationery have an important bearing on facilitating routine operations.

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While much of office machine work, such as ledger posting, is not necessarily monotonous, involving as it does the taking of decisions as to appropriate folio, nature /

nature of entry, etc., other aspects of it (e.g. addressing, folding, franking) more closely resemble the machine minding, often to be found in the factory. In this latter case, the work, although varied as regards documents handled, rarely calls for high intelligence and initiative. Such work might become monotonous to certain individuals, but here again the temperament of the worker should be considered. One person would find no monotony if put on routine work all day, while another would prefer to be on a job which called for some initiative. A certain type of worker becomes restive if too long on routine work, and the output suffers accordingly. In practice it is found that if these individuals must assist in routine work, an endeavour should be made to make the period a stated one. Interest is thereby stimulated and the output maintained.

It is admitted that office duties should rotate. Even the persons who prefer to be on routine work should have the routine work changed from time to time.

In the matter of responsibility some natures shirk anything approaching responsible work, while others expand and give of their best if responsibility is placed upon them. Experience has shewn that this latter type deteriorate if given routine work continuously, while the former are quite content to be on the same type of work all day.

Provided /

Provided the operator has been chosen with discrimination she will generally be able to make her duties sufficiently interesting and varied, because it is only in large offices that highly automatic machines are used. In other offices it is usual for machinery to be employed on a large variety of jobs. Very long runs of the identical process do not obtain from month to month (as in a motor factory where a model is not lightly changed) and no difficulty should be experienced in arranging for the rotation of duties within the capacity of the individual.

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The salesmen of machines are often inclined to foster the idea that the use of their machines is the whole art of office efficiency, whereas it is only a part, and often a minor part at that. There is, however, this credit to the machine that its very use promotes a scientific attitude and a precision of thought and action which is beneficial to the success of the whole organisation. No one, for example, who has used the dictaphone will dispute that dictation to a machine which will reproduce with mathematical accuracy every intonation and syllable given to it, tends to promote coherent dictation and precision of speech after any initial enmity to the machine has worn off. A new technique in dictation has to be built up, and office production benefits.

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The scientific attitude of determining how to get the best out of the machine finds expression in many ways. There are very few cases where there are no reactions on office equipment and requisites following the decision to purchase an office machine. Examples of such reactions may be cited. -

The adoption of -

(a) loose leaf or cards in place of bound books for ledgers and other records, even if required to be subsequently bound after completion,

(b) "unitary" documents as far as practicable in place of multiple documents,

(c) an efficient system of codification embracing a system of signals.

(d) an efficient system of sorting and grouping for bulk postings,

(e) listing to minimise posting, etc.,

(f) a regular spring cleaning process to test the utility of records,

(g) composite purpose records (often wholly or partly) simultaneously prepared which will give accounting, statistical and other records without recopying.

(h) The minimum of transcription - the original document should go as far as possible in being the permanent, and if possible, the final record.

(i) Periods for accounting, etc., should be made as long as is compatible with effective control, e.g. there will be a better "run" in ledger posting if these are "saved up". Other considerations such as daily balance of cash may, however, override /

override this consideration, but it may be possible to apply the principle to cost accounts.

(j) The system of reference, forward and backward, should be as complete, as simple and as automatic as possible.

(k) The utmost use should be made of sectional proofs and balancing to localise errors.

(l) Without necessarily inconveniencing third parties, wherever possible, get them to help you to run your business economically by using the appropriate forms, descriptions, etc. To do this it is usual to supply your clients with the necessary documents, etc., in the form most suitable for your mechanised system.

The adoption of -

(m) forms suitable for machine posting as regards size, texture, spacing, order of incidence of columns, readability of key positions at each appropriate stage in the cycle of operations, size, style and colour and combination of print,

(n) an efficient filing system,

(o) adequate intercommunication between departments.

Certain of these matters will be dealt with in greater detail elsewhere in this treatise.

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y or
sirable.

It is not suggested that extensive adjustments are inevitable to facilitate the successful operation of office machinery. For example, if there is an efficient method of codification and referencing, any problem of sorting and grouping may virtually disappear; or again, if a suitable unitary document can be applied to the business, making possible /

possible different sortings, transcription of information for other purposes may be solved. Or again, if "visible" loose leaf records are in use, the sorting of documents into sequence may not be worth while. Just as in considering the merits of a system of taxation the system as a whole must be considered, so, in planning arrangements for the effective operation of office machinery, consideration should be given to all the circumstances. In determining at what stage the maximum of labour shall be expended, the relative merits of its being undertaken at the various stages must be weighed in the balance against the ultimate work involved in avoiding it at that stage. This applies for example to the practice of ledger posting. If it is practicable to save up postings for, say, a week or even a month, a more or less continuous sequence of postings might be secured by interleaving the daily documents but here again considerations of daily proving and audit may outweigh the advantages inherent in this system. An equitable balancing of considerations is the only safe practice of the true economist.

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ources.

Before expensive machinery can be advocated on economic grounds there must be a change of attitude throughout the organisation. Departmentalism is a necessary feature in most large organisations, but it is usually based, not on office work or methods, but on industrial /

industrial processes or on stages in the evolution of a composite product. Where, however, an office is to be mechanised, sectionalisation on departmental lines may, to some extent, still be desirable, but instead of these being vertical, they ought to be peripheral, each making use to the maximum extent of the mechanised operations which the machines have been installed to do more quickly and cheaply than has hitherto been possible. The resources of a machinery section should be at the disposal of all departments, if their installation has been based on the work available in the whole of the office. The load for economical employment must be forthcoming.

Where, however, departments have equal claims on the services of a central machinery section, there is a danger in the creation of peak loads. Accordingly, some measures of relative priority should be determined so that the economies of mechanisation may not be dissipated by delays and inconveniences in the outlying departments. This is a matter of organisation, and organisation is a continuous process of relating "ability to do" with "needs of being done". A large measure of goodwill between sections, and a margin of elasticity in the capacity of the machinery section can usually minimise difficulties and inconveniences in this connection.

effective ommuni- ations help.

Closely associated with this pooling of resources is the /

the problem of effective communications. The moving of papers and similar material from point to point in the office by mechanical means has much to commend it. Conveyors, chutes, lifts, pneumatic tubes and endless belts, are now available which reduce the uneconomic movement of persons with consequent general disturbance and distraction. Distance may lend enchantment, but it certainly does not increase efficiency.

rinciple imul- eity.

The measure of the efficiency of an office machine must be judged, not by what it does, but by what it can do, and in order to ensure that the most economic use is obtained from it, it is desirable to map out in some detail the whole field of office operations to ascertain what the common denominator of these operations is, and how far sectional common denominators can be disposed of at one operation with a view to the elimination of duplication. One of the great dangers of office machinery is that it accomplishes the work of the office so easily that there is not the same urge to eliminate that work.

If we take an order coming into a firm prepared by the orderer, practically the whole of the information (or some of it) on that order will appear in the records of the receiving firm (with variations) at some time or another /

another in -

(a) departmental orders
(b) advice notes
(c) invoices
(d) label for dispatch
(e) account
(f) debtors' ledger
(g) cash book.

In many cases there is no valid reason why in preparing the departmental order, certain of the other documents should not be prepared or partly prepared at the same time in anticipation of the logical development of the order.

By the appropriate blending of sets of forms, blinding out of inappropriate sections of the information or masking carbons for certain copies, combined with good filing and timeous selection of the prepared or partly prepared documents, one operation of office machinery can often be made to serve for several. An example of the simultaneous preparation of Rate Demand Note, Valuation Roll, Valuation Ledger, is given in Appendix 19, ~~and of advice notes, invoice, label, and accounts of Lamsons Ltd. in Appendix~~ . The instances where simultaneous preparation of distinct operations can be carried out are very numerous indeed. Where simultaneous preparation is out of the question, the ready adaptability of the machine for consecutive operations is of equal importance. Particularly in smaller officeswhere a general purpose machine is /

is to be installed, it is important to consider the adaptability of machines for the various jobs. In addressing machines different spacing may be necessary for various forms, and a ready means of adjusting this should be looked for. Similarly, in an accounting machine, the ease with which the actuating bar governing the set up of the machine for a particular operation can be entirely changed or altered is a matter of importance.

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ntial.

The introduction of office machinery must to some extent upset the traditional methods of dealing with routine work. While tradition tends to perpetuate what experience has shewn to be the best methods under given conditions, it also tends to perpetuate that method when conditions have undergone something of a metamorphosis. For this reason it is desirable to review traditional methods from time to time. Inasmuch as the introduction of office machinery usually involves reconsiderations of work, methods and organisation, this is not the least among the advantages. A new outlook or a new approach to old problems brings the changes of conditions into their proper perspective and awakens the intellect to new possibilities. Everything should be done to let bright ideas come out into the light, by giving every encouragement to all members of the staff to make suggestions regarding the /

the operating of a mechanised system. All workers like to feel that their interest in the plant and equipment is a factor in its successful employment as it undoubtedly is.

Again, the constant repetition of certain operations by a member of the staff is the surest way to give birth to suggestions for its more direct or simple achievement. The organiser must always take a long view through the telescope if his schemes are to be successful, but the microscope in certain circumstances may be the more revealing.

Further, suggestions, even if out of the question as regards adoption, afford an opportunity for explaining the fundamental conceptions of the system to the staff in a way which leads to better understanding and appreciation of the aims. Without the sympathetic hearing of suggestions (which has a psychological effect on the individuals' self-esteem) and the explanations of the reasons underlying their non-adoption, the goodwill of the staff towards a mechanised system may be difficult to secure.

It would indeed be difficult to enumerate cases where the co-operation of the staff has contributed markedly in the successful operation of machines. "Best methods" have so often grown up even without the conscious suggestion by the staff, but the number of instances are considerable where /

where third rate results only are obtained because of lack of consultation with the routine workers. This may also be due to the fact that complaints (which are just inverted suggestions) are disposed to be more articulate than ideas, but a complaint must always be regarded as a reflection on the introduction of the machine.

The successful operation of machines is not a matter which comes automatically with the selection of the right operator and the right machine on the appropriate work, although this is undoubtedly the starting off point. The performance of each machine requires careful watching from time to time to ensure that full use is being made of it, and that output is not being hindered by adding to the machine operator duties which would more economically be done elsewhere. The difficulties involved in the measurement of output arise principally from the fact that the things produced are seldom exactly alike or homogeneous. The output of a posting clerk in a ledger department is usually measured by the number of entries he makes, but for the general inconvenience caused by erroneous entries no allowance in quantitative time can be made. A routine typist's output could be roughly measured by the number of documents she types, but allowance would need to be made for their /

their length, the number of copies, and so on. This is not to imply that any check on output is necessarily inequitable, but rather that care must be exercised in the manner of its application. Comparisons, in some circumstances, may be fairly made between outputs at different times, taking into consideration any changes which may have arisen in the interval. Again, comparisons between different machines engaged on the same operations afford some guidance in the relative efficiency of operation. Comparisons may also be made between actual performance and estimated output, provided the estimate has been framed on reasonable standards or best achievements, even although such optimum results are never obtained.

ice. In order to operate machines effectively, it is necessary to ensure that expert advice will be available especially in the early stages. The utmost advantage sh should be taken of the services of the makers in suggestions for the appropriate organisation. The price of the more expensive machinery usually covers extensive investigatory, advisory, and installation service, and in some cases free maintenance for a defined period. The proper manipulation and adjustment of complicated machines is not generally a fit subject for experimentation, yet even after the most careful tests prior to purchase, there are generally some unforeseen circumstances which arise after installation /

installation on which guidance is desirable. As already pointed out, through the conjoined efforts of user and supplier, many useful modifications of existing machines have been accomplished, and new uses found by the modification of work to suit the machine installed. The new models of many office machines embodying new features and designed for new uses owe much to this collaboration. The confidence inspired by adequate service arrangements does much towards ensuring effective operation particularly where experimentation in new uses is under contemplation. Inasmuch as this "service" is rarely confined to the mere mechanisation itself, but extends to all those other managerial aids such as control and audit, the view of some qualified person outside the business is often valuable in itself. Users of machinery early learn that the introduction of machinery involves them in other serious problems. They discover it is often easier to operate a machine inefficiently than efficiently, and that raising the operating efficiency may be a slow and difficult process. The efficiency of single operations must occasionally be analysed, as it is the general efficiency of all related operations that is important. The efficiency of sustained effort and overall efficiency is not always readily apparent.

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The operating of office machinery efficiently involves, too, a careful study of the allocation of work as between one machine and another. It may well be that certain operations can be equally readily mechanised in several ways, but it is a sound rule that the less advantageous manner must give way to the more profitable. For example, in the illustration given in Appendix No. 19 it is equally practicable for gross, net and rateable value to be inserted in the various documents by addressing or by accounting machinery, such information partaking very largely of a permanent nature. If done from the address plate, its insertion is automatic, but non-additive, and corrections require to be made in the plates from time to time. If done by accounting machinery, individual keying is required, giving an additive result and a productive proof. (Rateable value x rate = Total rates). The balance of advantage in this case lay with the accounting machine.

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lure.

Some light on the principles underlying efficient machine operation may be obtained from an examination of cases where little success has attended an installation. Too often the efficient operation of machines is rather apt to be assumed. Seldom do we hear of cases where a large installation is pronounced a failure. Idle and dust covered machines are to be found in the most unexpected places, not necessarily because there is no work for them to do /

do, but because those responsible prefer that work to be done by hand. Such preference may be due to mistakes in the choice of apparatus or to fundamental changes in the nature of the work itself or even to the initial mistake of finding work for a machine instead of a machine for the work. It is quite permissible to find additional work for a machine which is already justified on other grounds; otherwise, rarely can this policy be advocated with safety.

There may also be the failure properly to centralise all work that can be mechanised and thus create and maintain a full load for the machinery. The fault is not uncommon of overcentralising work and creating a "bottle neck", resulting in such delays that the machine operation loses much of its value. Then there is failure due to employing operators who are not of the necessary standard, whether by reason of intelligence, training or aptitude. In an endeavour to temper the wind to the shorn lamb, existing employees who might otherwise be displaced are sometimes transferred to machine work for which they are entirely unsuited, and, moreover, unsympathetic. In such a case there is no free selection of the apt persons for the type of work nor the incentive to qualify. In the opinion of the writer this is particularly the case with systems of office printing involving some measure of elementary type-setting. Two specific cases are in mind where /

where the standard of efficiency necessary to make office printing an economic proposition was not attained because the variety of the work did not permit of an adequate spread of the less efficient operation of type-setting.

Where supervision and control by one who not only understands mechanisation and mechanised accountancy but also the philosophy of management is lacking, the risks of failure are considerable. The occasion of mechanisation may also be seized upon to introduce some feature of re-organisation (perhaps not associated with mechanisation) which would never have been attempted in a similar way under any other circumstances, and office mechanisation may be unjustly blamed for consequential disasters (cf. Leeds case) (appendix 34). Cases where the failure may be very largely due to defects in the facilitative arrangements such as appropriate stationery and forms, filing arrangements, etc., are not unknown.

If efficiency is the aim, earnest work at the preliminary investigations is the only safeguard against statements and promises of the machine vendor - the superiority of "mind over matter".

s of lure.

Failure is a matter of degree. It may vary from something short of complete success to disaster of the most serious kind. Delay in producing the required results /

results or over costliness in their production, inability to maintain an adequate output, or unreliability of results, are but cases in point. It is only equitable in such cases to examine carefully the surrounding circumstances attending the machine operation, as it is often found that by certain readjustments of feeding arrangements, alteration in the cycle of operations, or the provision of better facilitative measures, much of the defective result can be eliminated. No mechanical scheme consists wholly of advantages, and, provided the drawbacks have been recognised and allowed for, there should always be a considerable balance of advantage in a sound mechanical system. Theoretical savings have a nasty habit of disappearing in practical affairs. The seconds saved here and there must be otherwise fruitfully employed if the Profit and Loss Account is to reflect the advantages claimed.

It is also true that in many mechanised systems the cost of much information got ready day by day is out of all proportion to its worth. The critical faculty in such cases requires to be developed. "Costing for Cost Accountants" might profitably have a new meaning.

Office machinery to-day is very reliable. It is not necessarily infallible. Errors due to incorrect touch, irregular manipulation, or to failure in operating certain devices are occasionally met with, and on rare occasions inexplicable /

inexplicable mechanical errors arise on a particular machine. But the probabilities of the breakdown or abandonment of a mechanised system are very much greater from the imperfect understanding of the person in charge in regard to the principles which should govern their effective operation, than from inherent imperfections in the machines themselves.

usion. Inasmuch as the capacity of the average accounting machine is equal to that of three clerks using the old-fashioned pen posting methods, and costs just about as much to purchase as the year's labour of the three clerks, it follows that it is particularly important so to organise the work of the office that the utmost use is made of it. To do this the working system of the office must be so arranged as to produce a continuous flow of work. This does not mean to imply that unless the machine is continuously employed, its installation can never be justified on economic grounds. As Professor Arnold Plant recently pointed out at a Conference of Management Associations, an efficient bathroom represents a considerable proportion of the cost of erecting and equipping a house, yet no one suggests that the bathroom must be in continuous use in order to justify it. Efficiency of results may justify the more or less casual use of expensive machinery, and the greater the efficiency of the machine, the less it need be /

be used. The modern folding machine or postal franker, for example, can be justified on a mere matter of an hour's use per day, owing to the speed at which they can accomplish routine operations.

But, as we must endeavour to make the machine available for all the work it can effectively accomplish, the choice of complementary equipment requires as much care as the choice of the machine itself. Incorrectly chosen equipment, or an unscientific layout of the installation, acts as a brake on the machine, the output of which is directly governed by the rapidity and certainty with which the machine operator can select accounts and post them. Non-productive periods may arise from two main causes, firstly when there is no work for the machine to do. This may be a measure of the effectiveness of the machine when it is working, or it may be due to the over-supply of machines. Secondly, short intermittent unproductive periods may arise from the operator being required to do operations which might more economically be done for her, or again from delays in the continuous supply of work, due to faulty organisation. The equipment, machine and system must be regarded as a unit, and speed and ease in handling considered for both the equipment and the machine. The employment of junior members of the staff in stuffing or marking /

marking accounts to be posted so that the operator can work through the ledger without the necessity of locating an account, has long been recognised as advantageous, and the restoration of the posted sheets to proper sequence by non-operative staff follows naturally as appropriate division of labour. By applying this principle there is not the same necessity for the operators of the machines to acquire intimate knowledge of various ledgers when their specific function is machine operation according to a well defined rhythm. Few expert operators are expert at these side operations also, and small losses multiplied many times may mean a considerable decrease in efficiency.

It is indeed surprising what a difference can be made when environment and modern equipment suited to the work is provided in the office. Temperament and output subconsciously improve in an atmosphere congenial to getting on with the job, but the spirit of that atmosphere is organisation.

In offices, improved results are often secured by improvements in the organisation involving adjustments in operation itself. An office is a production department similar to a factory, the products being the statistics required for effective management and for control of the business. The problems involved in replacing manual methods by mechanical are similar to those of the factory, and /

and factory experience has proved that both organisation and methods may require to be adjusted in order that machines may be kept in constant production for a high efficiency to be attained. Frequently, the mechanical equipment has been adjusted to fit in with the existing office system. In some cases this is successful: in others it is not.

The factory practice is to install the machinery and make the adjustments round it in order to ensure its operation to capacity. It may well be that this practice will be adopted generally in all offices.

In the factory, every detail of power plant operation is recorded and carefully studied. Many good results have ensued from the study of such records. A stoker's efficiency is not measured by the large amount of coal he shovels, but by the smallest quantity necessary to maintain the head of steam.

"On an average every business is about 10 per cent. "technical and 90 per cent. ordinary .... Few "business executives realise that and their main attention "is concentrated on the technical side. For that reason "the technical section has a high efficiency of operation. "it is, however, in the ordinary sections where the losses "occur".

Efficiency must, moreover, be an over all efficiency, and /

and this can only be secured by adequate control over all the activities of every section through the effective co-ordination of related effort, and it is better that this should be secured early in the installation of office machinery.

The identification of the causes of failure is of more importance than the determination of the exact amount of the adverse balance. No post mortem is of benefit to the victim. Only reliable and timely diagnosis is of real value. When the rain is on, the leaks in the roof must remain as the time for repair is inopportune. When the weather is fine it is so often thought they don't matter. Surely it is better to have the roof examined from time to time when it is appropriate. It is equally important that a machine installation should be the subject of a periodical review, and the suggestion is made that a complete revision of the methods should be made every ten years. This is advocated for several reasons.

In the first place, original plans and conceptions tend to be departed from by almost imperceptable gradations, until it is not uncommon to find that the final methods bear little semblance to the original plan. This may be good or bad, but the conscious application of the critical faculty should bring about the perpetuation of what is best in an active method and the elimination of what is wasteful.

In /

In the second place, progressive improvements in machinery take place so quickly that it is often advantageous to trade out older models and to adopt the later models embodying these improvements. If it was originally an economic proposition to employ the machinery on routine work, it may well be as advantageous to profit by the subsequent improvements without any fundamental alteration in the mechanised system.

In the third place, the intervening development in staff outlook towards mechanised methods may make it possible to make considerable extensions in the application of machinery with further profit, and with a much greater degree of security for success than was possible in earlier days.

Fourthly, in this interval the substantial nature of the work may itself have undergone such a metamorphosis that the machinery ideal for the work at that time is no longer suited to the altered task.

The collation of experience gained in such a period must be as consciously done as it is unconsciously acquired. It is only fair too, to the management to indicate how far the journey towards the promised land, so pleasantly described at the initiation, has been traversed.

Office work is growing, and increased work means increased staff and increased costs spreading to supervision, etc. The vital consideration is how to get increased /

increased work done at minimum increased cost by improving the individual output. The rate of labour costs has risen steadily during the last fifty years. The employment of costly machinery may, in the long run, be the cheapest and best method of coping with these conditions, but unless the best results are obtained from its use, the disadvantages of introducing what is essentially one-way traffic into an otherwise flexible organisation may outweigh all other benefits.

CHAPTER IV.

Machines and their Efficiency Features

"Are not the excellence, beauty and correctness of every manufactured article .... to be tried only by reference to the purpose intended in their construction."

Plato.

oductory.

Before selecting a machine or machines intended to effect improvements in office work, many factors must be taken into account if advantage is to be taken of the economies which mechanisation affords. It may be assumed that the prospective purchaser has an adequate understanding of the work on which he proposes to employ the machine. The primary consideration will therefore be the selection of a machine designed for and capable of doing the essential work in the best way. All other considerations must be subordinated to this, although in appropriate circumstances the requirements of the accountant and auditor cannot lightly be brushed aside. The selection will, however, be greatly facilitated by an understanding of the principles of the machines themselves and of the values to be attributed to their differing principles.

It is proposed in this chapter to consider various machines and to explain briefly the significance of the main features affecting their economic use with a view to affording some guidance in their selection.

It /

It may be pointed out that a classification of office machinery according to any well defined grouping can never be entirely satisfactory. Many modern machines can be regarded as multipurpose. Others are so highly specialised that only an individual consideration can be adequate. A broad grouping based on a suggestion by P. T. Lloyd (The Technique of Efficient Office Methods) will, it is considered, meet the purpose here in view, viz. -

(a) Accounting, calculating, book-keeping, billing, tabulating, cash registration and receipting.

(b) Duplicating, stencil, copying, addressing, photography.

(c) Dictating and typewriting.

(d) Progressive stamping, time recording, and numbering.

(e) Protective devices.

(f) Simple manipulative machines, e.g. opening letters, stamping, sealing, coin sorting and counting.

(g) Automatic recorders.

unting. "Accounting operations when resolved into their most "simple elements consist in placing certain figures in "certain positions on sheets of paper and in aggregating "(+ -) such figures under certain combinations". The exact nature and frequency of the figures to be recorded and the layout (vertical or horizontal) have to be carefully considered, as also has the "marriage" of these /

these figures with something else by way of description or code, while the dimensions of the figures involved, their analysis or grouping ~~is~~ are also of importance. In some cases this grouping may be across the page, in others down the page, while in many cases grouping across and down the page is required. It is moreover desirable to know what are the basic and essential needs and what are merely optional, and to have in mind some order of importance for the many desirable features which are now available, if a wise selection is to be made.

alculat- machines.

While in some connections the term "calculating machine" is used to denote a device for multiplying; division, addition and subtracting are essentially forms of calculation, and it is proposed to consider all such machines falling within this group. In selecting machines it is, however, necessary to determine at the outset whether additions (and subtractions) or multiplications (and divisions) are required, bearing in mind that multiplying machines will always add, subtract and divide. Accordingly, the relative incidence of adding and subtracting as contrasted with multiplying and dividing, should be considered as a deciding factor in the type of machine to be selected. Crank drive machines, for example, are not so suitable for adding work, although they may have superior /

superior advantages for multiplying and dividing.

'rint v. print.

The first feature to be considered is whether printing is desired or not. All known calculating printing machines are of the key setting kind, i.e. the operation is subdivided into selecting the type to be set up and then operating the printing device. Non-printing machines may or may not be key-setting machines, or may be partly key setting and partly key driven. A key driven machine is essentially faster in operation, but as it leaves no permanent record of the transaction, checking is just a repetition of the whole operation. Considerations other than the mere operation must determine the importance to be assigned to printing versus non-printing feature. Such considerations may, for example, be the need or otherwise for office records for audit purposes. In extensive organisations, it will generally be found that there are needs for both types of machines. Broadly, the distinction may be stated that printing machines (of which the adding-listing is the commonest example) give evidence and results - non listing machines give results more speedily, but preclude the subsequent utilisation of all intermediate calculations.

Full v. ırt key- .rd.

Full keyboard machines operate on the principle that the position of the key operated determines its value. Accordingly, intervening zeros require no operation with a /

a consequent saving of time. Short keyboard machines utilise the same keys for different values, the values thereof being determined either by the additional operation of a position or value key, or by the key operation of all intervening zeros, or by carriage position. The advantages of the full keyboard may be broadly stated as logical arrangement. The value of 8088 is determined, not only by the figures employed, but also by their position in relation to each other, and the operator has nothing to do but transfer significant figures and position to the keyboard. If such machines are also key driven, there is no further operation necessary to record the transaction. Accordingly, speed can readily be acquired and possibility of error is minimised, because the two dimensions of value and position both create a momentary mental picture. Good space and position perception is, however, required on the part of the operator. If, however, an error has been made after the keys are depressed, the transaction having already been completed, correction may involve a fresh start to an extensive series of operations. If the principle of key-setting only is employed, the last transaction may be corrected before it is too late. This full keyboard is essentially made for two hand operation, and may be a disadvantage where one hand is required for turning over documents. Hence skilled operators very often confine their /

their operation to the lower portion of the keyboard, additional keying of which (5 + 4 = 9) will give the same result and also facilitate a development of the touch system.

The short keyboard comprising keys 1 - 9 (up to 11 for Sterling) has decided advantages in enabling touch operation to be rapidly acquired with one hand, permitting the other to be free for handling the documents and to keep the eyes continuously selecting from what may be complex tabular statements.

In the determination of the significance to be attached to the feature of the keyboard, a balance of considerations must be struck according to the nature of the work, but it is of some significance to note that the earliest adding machines only had ten keys, because they could only operate effectively one column of figures at a time, and the multiple or full keyboard is but a building up of several early machines (with connecting carry over) into one. The modern short keyboard only dates from 1914 (Sundstrand), but is rapidly growing in favour. There are no known reliable and unbiassed statistics available to prove the relative merits of the two keyboards. There are two variable factors, the nature of the work and the operator, and on these, general rules of guidance cannot safely /

safely be founded.

) Key-ting v. drive.

In a key setting machine, as already indicated, the operation consists of two distinct stages, viz. the setting up of the type and the taking of the impression, or other completion of the transaction (e.g. aggregation). This sub-division has a decided advantage. It is a well known experience of every typist that she rarely strikes a wrong key without being immediately aware that a mistake has been made. In a key driven machine such as the typewriter, the damage has been done. In a key setting machine the figures can be reset before the motor bar or actuating lever is operated, and thus a timeous correction can be made. The split second to do the second part of the operation, although a waste of time compared with the key drive, may be a saving in the end, for the less highly skilled operator. But again, this must be judged in the light of other considerations (cf. error incidence, complexity of calculation). Further, in this type of machine a partial depression of a key (which will forthwith jump up again) is readily noticeable. The key drive, particularly if electric, is faster, and if an error key, which can as quickly eliminate only the error, is provided, the balance of advantage in favour of key setting may be minimised. The possibility of partial depression of a key is also safeguarded against in modern machines by an automatic /

automatic locking of the keyboard and more particularly by electric drive. There is one important disadvantage in the key driven machine, however. Where a series of calculations are being done separately and accumulated at the same time, individual answers are not available. If an error occurs during such a continued transaction and is observed as regards its occurrence, but not as regards its specific amount, the whole series of transactions may require to be done over again.

A contrast might appropriately have been made here between key drive and crank drive calculating machines, although some crank drive machines are key set, while others are lever set. It may be stated broadly that the key drive has advantages for mixed work (adding, multiplying, etc.) provided skilled operators are employed, while the crank drive type lends itself to manipulation by less expert operators and is, on the whole, better for the more complicated types of calculation where speed is not the paramount consideration.

Constant variable [fac]tor.

Where much of the accounting work involves the calculation (multiplication and division) with a relatively fixed factor, the selection of a machine which enables that factor to be held down at will until a change is necessary, affords much economy in time in keying operations. At least one of the short keyboard electric machines capable of /

of adding and printing can also deal in this way with repeat additions and subtractions, subject to this precaution that the repeat must be stopped one calculation short of the final. This is necessary because the last calculation is required to release the repeat mechanism itself. Constant factor machines are of considerable assistance in working out interest, wages, etc., where considerable runs at one rate are available.

Type v. bol.

Inasmuch as there are, on the one hand, composite machines available for combining accounting operations with normal typewriting for descriptive matter, and accounting machines with the addition of a limited range of symbols for differentiating classes of figures, it is necessary for the person selecting machines to make up his mind very early in his investigation whether full typewriting matter is essential, or whether a brief differentiation of items will suffice. It will readily be realised that to add typed descriptions to an accounting operation will retard operation and involve a much more comprehensive keyboard. If, however, by doing one extensive operation once, thereby fulfilling the requirements of several records (Cash Book, Ledger, Invoices, etc.) at one operation, the saving may ultimately be considerable. If, on the other hand, the full descriptive distinctions can be obtained by suitable headings on ledger cards, etc., and the operation of single symbol /

symbol keys at the same time segregating the amounts into appropriate registers, the selection may be confined to such machines, and the maximum additive capacity obtained for a given expenditure of money.

Automatic [...]re print reading of [...]wer.

One of the justifications for the installation of office machinery is the elimination of error. This has been furthered through the degree of automaticity possible in the results obtained from the operation of machines. If certain keys are depressed on an adding or accounting machine designed for accumulating, then (apart from the rare mechanical defect) the accumulation will be the exact total of the separate operations. If the machine is then made to deliver up the answer by a print, the human element is not afforded any opportunity to create an error in the translation from machine storage to printed figure. There are, however, accounting machines where the printing of machine stored figures is not automatic, i.e. where dials have to be read and printed individually figure by figure, thereby making possible an incorrect transcription. True it is that this weakness has been foreseen and that devices have been introduced into such machines whereby attention is arrested on any occasion where the amount keyed does not correspond with the dial reading, but there is the fatigue, anxiety and visual strain of reading dials and /

and interpreting the message into keyed operation with the possibility of being held up before the next operation. This procedure is entirely eliminated in the case of certain built accounting machines. On the other hand, the flexibility of "cyclometers" or "totalisers" lies in the fact that they can be set to variable positions, added to and arranged in various combinations according to the needs of the moment. Alteration is more difficult with a built machine which is adjustable only by alterations to an actuating bar and only within the limits of its fixed capacity.

) Carriage machine rement.

A distinguishing feature of some moment in the selection of accounting machinery is the nature of the forms, etc., to be used. While in some cases it may be possible to adjust the records to a form most suitable for the best machine, there are other cases in which the merits of a particular form of record outweigh the advantages of mechanical posting. There are several factors to be taken into account in a decision to select a machine with a moving carriage, i.e. a carriage the successive positions of which not only carry the figures to different columns or classifications but also bring automatically into operation the functions (predetermined according to a plan) of non-add, non-print, repeat (add or print), subtract /

subtract symbol, return carriage, space up, etc. Among these factors are:-

(a) size, nature and periodicity of documents,
(b) number of copies required at one operation - carbons,
(c) ease of insertion and removal of documents,
(d) visibility,
(e) ease and accuracy of alignment,
(f) position, i.e. regularity or otherwise of entries.

Many of these factors have a considerable influence on economic operation. As already indicated, the size and nature of the documents may be statutory or otherwise unadjustable in any material aspect, and their very nature may suggest the choice to a flat bed machine which (even where folding is unavoidable) will accommodate paper of a size it is necessary to use. Again, the need for total visibility, owing to the irregular positioning of entries as occurring in the documents of original entry, may further determine the nature of the machine to be preferred. The possibilities of adopting continuous feed methods may, as is usual, be equally applicable to both types. Where numerous copies of documents are regularly required at one operation, or where several small documents must continuously be kept set up in readiness for immediate completion (e.g. drivers' licences), serious consideration should be given to the moving machine (flat bed) type which has peculiar /

peculiar facilities for manifolding and for transference from one form to another. The amount of time which is involved in the countless insertions and removals of carbons may be considerable and detract from the full advantages accruing to machine operation. While it is true that line and space finding devices are fitted to moving carriage machines and alignment difficulties can be overcome by careful planning of forms, yet a time study will afford the best guide in the selection of the most appropriate type of machine. The ease of operating continuous stationery (several copies) through transverse carbons (capable of ready change to new surface) on a flat bed machine combined with visibility, prompt placing and alignment and good copies, are the outstanding features of the moving machine type. It must, however, be conceded that such machines are heavier and less convenient in operation, are usually more noisy and decidedly less automatic than machines which function through carriage movement. In such machines, almost complete control of movement is obtained from the keyboard with consequent enhanced speed in operation. Both carriage and machine movement may also be obviated by extensive keyboard arrangements (see paragraph on full keyboard p.135).

.) Electric on- tric.

While the matter of price must always be taken into consideration, the relative merits of electric and non-electric /

non-electric models should be considered. The greater ease and certainty of operation which the electric motive power ensures, and its facility for furthering the development of additional automatic features, makes the electric model, in most cases, an attractive proposition. A distinction may well be drawn between machines which are electrical only as regards the accounting keyboard operation and those which are fully electric in all movements, such as carriage return, vertical spacing, between those which have a continuously running motor and those where the motor only operates on depression of motor bar, between those which are virtually silent and those which involve considerable mechanical noise. The choice between electric and non-electric models will depend on the work to be done in relation to the facility with which this can be accomplished, having regard to accuracy rather than cost.

) Visility.

While in theory the expert operator should not require to see the results of her operation, there is little doubt that the momentary glance at the results of each operation is an apt safeguard to the efficient operation of a machine. While there are few non-visible machines now on the market, there is one very efficient machine (Moon Hopkins) where visibility is not available without the deliberate lifting of the carriage. While this is due to an obviously sound method /

method of machine construction, it is undoubtedly a disadvantage to some extent except, perhaps, where the nature of the work involves the changing of the document at each operation. In this case a glance is afforded while removing and inserting the next sheet.

lethod 'eed. Inasmuch as many accounting operations involve the regular changing of documents to be entered up, the degree of facility with which this can be done greatly affects the output. Broadly, there are four methods presently available, and the determination of the appropriate one will depend on the nature of the work. Particular attention must be given to ease of alignment where this is not constant. These methods are:-

(a) Platen feed where documents have to be wound round a platen.

(b) Front feed, where, in addition to possibly a platen feed for a relatively permanent document, the insertion of an ever changing document has to be done at each entry.

(c) Flat feed, wherein the changing documents require only to be clipped on a flat bed in appropriate alignment.

(d) Continuous feed, incorporated with (a) or (c), where the removal of one document brings the next into appropriate position.

Platen feed is perhaps the most commonly used for general purposes, and has the advantage of flexibility, variability of margin, writing space, and ease of interlining with /

and
with adaptability for front feed of small cards,/ease of
These
removal./are among the obvious advantages.

Front feed is a more modern development, particularly useful for public utility machines engaged on the preparation of standardised accounts.

Flat feed enables cards which may be too rigid for platen feed to be used. It is also useful for large sheets which may be folded if necessary for insertion of figures. A folded sheet is inconvenient for use with platen feed. Even books may be entered up on a flat bed machine, and positioning of different sized documents is particularly easy under this system.

Continuous feed on the roll or fanfold system, together with a device for correct alignment and registration by pinwheel feed or special platen, greatly increases operating speed, provided frequent changes of forms are not necessary. This principle may be used in conjunction with "one time" carbons or transverse carbon feed.

It cannot be too strongly stressed that facility in handling the documents is a matter of primary importance in machine operation, and this factor must always be weighed in its proper relation to the others already considered.

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ters.

It may be stated as a generalisation that the greater the number of separate analyses required, involving as these do, the provision of the greater number of separate registers, the greater will be the cost of the machine, the slower its operation and (except in the case of wholly automatic machines) the greater the liability to error in its use. Accordingly, economic factors may here be diametrically opposed. On the one hand it is desirable that the machine, in contending with the minimum requirements of the job, should simultaneously do the maximum work of which it is capable; on the other, the operation should be made as simple and as foolproof as is practicable, especially where such simplicity brings with it a reduction in capital cost and in cost of operating. An equitable solution can generally be arrived at by an inductive study of the various analyses in order to determine those which must be done at the time, from those which can be done later by a separate, and perhaps simpler, operation. For example, if there are twenty possible analyses, while 98 per cent. by volume can be covered by five registers, a six register machine might be the most economical. The sixth register can be made an omnibus one in which coded symbols are used for subsequent sub-analysis. If, however, the documents of original entry /

entry may never again be found sorted into the appropriate order, it may be sound economy to utilise them for a detailed analysis at this particular stage, because manual sorting is a slow process.

) Form of
of.

In all accounting operations the ultimate criterion of efficiency is accuracy. The earlier that a proof of accuracy can be obtained, the greater is the efficiency, and it is no exaggeration to say that machine accounting in its various forms has made its greatest contribution in this connection. The forms of proof available to the accountant are almost as varied as the types of machines themselves, and many of these proofs can be made so "sectionalised" as to ~~greatly~~ facilitate the localisation of discrepancies when they arise. Forms of proof are found in a variety of combinations according to the nature of the operation. Four only will be here discussed in principle.

(a) Principle of proving aggregate transactions against independent pre-determined total. This method implies that where a machine is used to record transactions such as posting separate expenditures to a ledger, it will simultaneously accumulate these transactions. By depressing the appropriate keys a record will be given which should agree with some independent pre-determined total /

total, such as might be obtained direct from the documents of original entry. This form of proof is immediately available at the end of each run, but it does not preclude the possibility of compensating errors, or of erroneous allocation among the separate accounts. If, however, it is conjoined with codification to ensure that account 123 has 123 - as taken from document of original entry - against each posting, and a visual check as accounts are removed from the machine, this method is reasonably satisfactory, particularly where a proof roll is furnished. Such a proof roll can readily be checked over to locate the difference.

(b) Principle of pick up. If each transaction is made to embrace the picking up of old balance, the posting, and the mechanical throw out of new balance, each of these three being additive and conjoined with (a) a system of control cards for recording all totals, and (b) an independent predetermined total of the transactions, and (c) the need for subtracting the old balance to clear the machine at each operation, the system is as nearly error proof (apart from wrong allocation) as it is possible to obtain.

Broadly, the proof is -

Accuracy of aggregate pick up of old balances - obtained from control card recording the aggregate of the (then) new balances.

Accuracy /

Accuracy of aggregate transaction posted - obtained from predetermined total.

Accuracy of each horizontal entry - obtained mechanically and from the mechanical need to clear the machine.

A check on the aggregate of the new balances - obtained -
(i) from next day's independent pick up, and
(ii) from a check in aggregate -
Old Balance $\pm$ transaction = new Balance on control card - which is also done mechanically.

(c) Regular machine clearance - the totaliser principle where the postings as in (b) above are transcribed from dials instead of being produced mechanically, but only the correct reading and reproduction will allow the machine to proceed to the next operation.

(d) Cross check of accounting and statistical records - The principle of using the same basic documents (duly registered) for both accounting and statistical purposes is a practice which has many points in its favour. A case of common application arises in connection with cost accounts. In almost every business in which wages and materials are expended in the production of articles for disposal or for subsequent process utilisation, wage records and stores issue vouchers, constitute the documents of prime record both for the financial and the cost accounts. Where /

Where these are utilised in one arrangement for the financial accounts and rearranged in another for the cost accounts, the agreement of the machine totals derived from each form of posting affords a reasonably reliable proof of accuracy, besides ensuring that the cost accounts themselves can be utilised for estimating purposes with a high degree of safety.

While the possibility of obtaining adequate and systematic proofs of accuracy can never be absent from the mind of the selector of accounting machinery, it is undoubtedly true to say that the primary consideration must be to get the work done and to get it done promptly and with a high degree of clarity and reliability, but it is equally true to say that almost any system of machine accounting will afford, as a by-product, opportunities for proof of accuracy which is unattainable by hand methods. The D.P. (Duplicate Posting) Manual system is the nearest approach to the sense of security which machine posting so consistently affords.

ii) Possi-
lities of
mbined
erations.

While the early approaches to machine accounting may be actuated by the desire to accomplish some specific function, it is advisable to use imagination throughout the study of the particular problem, so that advantage may be taken of every possibility to combine operations, even if this involves minor modifications. The second

best /

best procedure for accomplishing the primary object may prove to be superior if conjoined with the accomplishment, even in part, of some other essential operation. The desirability of so combining operations may in fact be the determining factor in the selection of the machine itself. It is not often realised how much common information anent one transaction is embodied in the various office records. It is an economic maxim that production is not complete till the product is in the hands of the consumer. To complete the production of an accounting transaction there may, for example, be an order, works order, cost account, advice note, invoice, account, ledger account, cash book entry, receipt, etc. When machines are to be economically employed in office work, selection must be based on the requirements as a whole. "Specific function" does not recognise the otherwise convenient subdivision of office records. It goes to the root of "operation" and always seeks for the greatest common factor as the basis for mechanisation. Examples of combined operations are legion. Appendix No.20 gives a table of significant examples.

r) Capacity registers i keyboard nbols.

While accounting machines in a particular class are built according to a common principle and marketed on the basis of average requirements, the actual figure capacity and symbolisation is a matter for particular adjustment. It /

It therefore falls on the buyer to intimate his requirements for the purpose in view. Sections of the keyboard can be set aside for symbols and other non-additive functions, but use for such purposes usually restricts the accounting capacity of the machine. As the figure requirement of totals is greater than that of the details, it follows that totals must first be determined as a guide to the selection of size and class of machine. The possibilities of sectional balancing and the consequent shortening of accumulations in the machine should be carefully considered. Natural divisions for which totals are necessary in any particular business and the grouping of totals for grand totals must also have due weight. Errors which take place in the non-mechanical handling of totals may be much more serious than those arising with transactions of detail. It is not usually difficult to arrive at a fair compromise on this matter. Where several machines are used, it is often practicable to differentiate and have, say, only one with figure capacity to deal with the accounting for the dimensions of the probable grand total. Economy in the purchase price of the whole machinery can often be secured in this way without losing the full advantages of mechanisation. Similarly as regards symbols so essential to the differentiation of entries, an extended range of these can sometimes be secured without loss of accounting /

accounting capacity by having different groups of symbols on different machines of the same class.

Other features.

There are numerous other features affecting the economic application of accounting machinery to office work which are worthy of brief mention. The clarity of the records, the facility with which repeats and duplicate copies can be obtained, the relative ease and speed of operation, the precision of tabulation and alignment, the automatic insertion of dates, the provision of sub and grand totals, the automatic colour change for debits and credits, the automatic elimination of additions where these would have no meaning, the automatic insertion of noughts in certain keyboard machines, punctuation, spacing and carriage return, the possibilities of analytical statistics, and, finally, the provision of receipts as a by-product of accounting operations, are but a few of the features affecting the efficiency of accounting mechanisation. Enough has been said to indicate that the economic application of these devices to accounting problems is not one which begins or ends with the determination to lay aside pen and ink. The machines themselves have been built on the average requirements of business. Few office needs conform with this average. Most office systems are capable of some simplification or adjustment. Most machines have a measure of adaptability, and their classes are /

are already many. Ingenuity on both sides can usually bridge the gap and at the same time satisfy the major accounting principles, provided the care and thought is put into the problem, the true balance of advantage is fairly sought, and the ideal is never lost to sight.

ssing ines. The term "addressing machine" under modern conditions is something of a misnomer. In its inception, its object was the printing of names and addresses on envelopes, cards, etc., but its scope and capacity is now very extensive. An addressing machine is a device which takes a number of previously prepared names and addresses and other relatively permanent particulars, and reproduces them (or such of them as may be chosen) as and when required, with the least possible delay, with the greatest degree of accuracy and automaticity and with the utmost clarity and convenience in one or several forms according to a predetermined plan, plates or stencils being fed automatically. These machines are available in a variety of types and styles, and the purpose of the following remarks is to afford guidance in a right selection, according to the significant operating features. Efficiency in the use of this appliance must be assessed in relation to the variety of its possible applications. The addressing of envelopes, labels and wrappers, is but one of the simplest office /

office uses of an addressing machine. Time cards, pay envelopes, pay bills, dividend and interest warrants, superannuation records, invoices and advice notes, ledger sheets, accounts, assessment notices, stock lists, route lists, valuation roll, factory form preparation, are among the uses which come readily to mind, while the use of the plates themselves as an index should not be overlooked. In view of the many uses to which such a machine may be put, it is the more essential that, all things considered, the appropriate type of machine should be selected. Fortunately perhaps, the choice is more restricted, and certain fundamental considerations still further narrow this choice.

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te.

The first consideration in the selection of an addressing machine is whether more than one copy is likely to be required from one operation. If, under all conditions of use, only one copy is required at a time, a machine operating by a stencil may suffice. There are undoubted advantages in a stencil machine. It is relatively cheap, not only in capital but also in operating cost, e.g. stencils. Further, the stencils can be prepared on an ordinary typewriter with the sole adjustment of two clips round the platen to hold the small framed stencils. This obviates the need for having noisy power driven embossing machines on an operating principle /

principle which may be quite different from that involved in the typewriter keyboard (e.g. rotary). There is also this advantage in a stencil machine that the weights to be handled by the operator are quite inconsiderable compared with metal plates. This problem of weights in a large installation may involve the consideration of floor stresses and the positioning of the equipment. The durability of the modern stencil is good and minor corrections can be made on them quite effectively. Where, say, a whole line requires correction, it is usually more economical to replace the whole stencil. The complete absence of noise in the movement of stencils is also a point in favour of this type. The readability of the stencils after first use dispenses with the need of further indexing, as the stencils themselves can be filed according to a desired order.

On the other hand there are certain disadvantages in the stencil principle. The number of automatic selections is rather more limited, although visual selections are possible through use of different colours of frames. The impossibility of having a varying panel in an otherwise fixed stencil may also in certain circumstances be a disadvantage. The inability to take a carbon copy of the print at one impression may, however, be the deciding factor /

factor against this type, nor is there the same facility for printing only a part of the stencil at one time.

The plate machine differs from the stencil machine in that the printing medium, instead of being a stencil through which ink is permitted to percolate, is an embossed metal plate which is pressed against an inked ribbon to give a printed impression. There are two main types, the one operating by a one-piece embossed plate, and the other by a frame with embossed panel. Each have their individual merits, the most suitable depending on the circumstances and on personal preference. The main advantage of the plate machines over the stencil type lies in the fact that, as the machine relies on an impression through a ribbon for reproduction, several carbon copies can be taken at one operation and semi-absorbent paper which is often unsuited to subsequent clerical operations need not be used. Experience has shewn, however, that, unless the utmost care is exercised in the selection of suitable papers and of carbon paper, and pressure on the machine is adjusted to suit the conditions, it is by no means invariably easy to secure satisfactory carbon copies. An original and two copies is about the maximum that can be relied on under ordinary circumstances. Nevertheless this may make all the difference to the economic useful; ness of the addressing machine. The number of corrections which /

which can be made on a plate are also considerable, as many as five being possible on the same surface. Where corrections are varied over different parts of the plate numerous alterations can be made. The whole plate can also be blanked out very quickly and re-used. Facilities are also available whereby a mass of plates can be sent to the makers for mass blanking out with consequent saving in time. In the frame and panel style, removable panels are provided which are most useful under certain circumstances. For example, where there is a fixed establishment of staff in various grades, but changes take place in personnel owing to promotions, etc., it may be possible by withdrawing names and replacing new panels appropriate to new grading to keep the whole equipment up to date with the minimum of re-embossing. Similarly where addresses are permanent, but tenants change, a removable panel for tenants names may obviate blanking out (owing to low cost of line panels) new names being inserted when the old ones have been removed. A careful analysis of the incidence of corrections will assist in the proper selection of the appropriate type of plate. It may be pointed out, however, that plates of one manufacture are only capable of use on the machine for which they have been designed. The development of a complex system of automatic selection (see later) is also possible with the plate machines to a greater /

greater extent, and plates can also be masked, for visual selection to equalise with the advantage of the stencil, in different coloured frames. The facility with which certain portions of the plates can temporarily be put out of use for certain purposes by the use of cut out pads also adds to the advantage of the plate system.

The main disadvantages of the plate types are noise, weight and cost.. A certain amount of noise is inevitable from the dropping of plates into a receiving tray, while the weight of a large installation may be considerable. In view also of the speed at which operations can be completed (about 6,500 per hour) about 170 trays of plates may be lifted and removed by an operator in a day, involving the handling of over two tons of metal. There is also the cost of the installation and its annual costs in plates, etc., which range around £4.10/- per 1,000 exclusive of embossing. A separate embossing machine is also involved in the installation which adds materially to the initial costs.

The decision whether a hand operated machine or a power driven one would best serve the purpose in view is also a matter which must be determined on the basis of cost compared with relative demands to be made upon the machine. It may generally be stated that, in so far as the greatest refinements and flexibility is available in the /

the electric models, it will generally pay, except in the simplest and smallest installations, to make use of the power driven models. The hand models are designed primarily for the rather limited application of addressing, low priced models being available for the very smallest business.

tor v. Selector ls.

The broad distinction between non-selector and selector models is that, whereas the former will, apart from the deliberate skipping by the operator according to a colour or other visual plan of differentiation, print all plates as they come into printing position, the latter will automatically print or skip the plates having certain selections embossed or affixed to the plate. Just as society comprises different classes, each class having within it different families comprising distinct individuals of each family, so "address" plates may be arranged into different categories, each category having its family group of distinct members. As for each class of society there is a standard of life, so for each category of plate there is a standard plan or lay out. While each family in society has its own associations and mode of life, so each family of plates is bound together by mutual relations. In society the identity of each member of a family is readily known to each other member. In an addressing system /

system likewise, each member of a family of plates is readily distinguishable from every other member under a planned system of automatic selection.

This result is achieved as follows:-

(1) Classes of plates are designed according to a plan determined on the basis of the purposes for which they are to be used. Classes of plates are kept separate. In this way the same cut out pads can be used for different purposes with different classes of plates, and selections can also be assigned different meanings with different classes of plates.

(2) Families of plates in the same class are kept together in the tray and tied to each other by the use of selections. The family may vary in its number of members. A class of plates comprises x families.

(3) Individuals in the family are distinguished from each other by selections (Leader, follower 1, follower 2, etc.). Leading plates of each family have the same plan. Follower plates having the same selections (or combinations thereof) have the same plan.

In Appendix No. 21 an example is given of the working out of such a system. It may suffice here to indicate the principles underlying such an arrangement.

An automatic selector machine is an unthinking instrument. It must be told what to do. Of its own volition it cannot differentiate, but it may be actuated according to a plan. In planning each of the plates of a class (and entirely different plans can be made for different classes separately passed through the same machine /

machine) the same nature of information must appear on the same section of the plate (e.g. names on the name portion, addresses on the address portion, etc.) so that if a pad for cutting out names is used, only names will be eliminated. If in the "class" a departure is made from this positioning of information, a selection must be brought into operation to correct the machine operation (telling it to print or not to print as the case may require). Additional selections (up to the capacity of the equipment) can be applied to operate positively or negatively so as to make the selection of plates so selective that only certain members of the family in the class are used for certain purposes.

One might paraphrase this technical aspect of selection by presuming an instruction to the machine in the following terms -

$$\frac{\text{Do (positive selection)}}{\text{Do not (negative selection)}} \text{ print the specified part}$$

(cut out pad) of certain of the following plates (the class is automatically selected) provided you $\frac{\text{do}}{\text{do not}}$ receive instructions in the interval (selection) to the contrary.

The selectors are made and are operative in two distinct ways. On the Adrema plate the selections are embossed on the plate at the normal time of printing, and these embossings make certain electrical contacts while passing /

passing the pre-printing position. This determines, according to the selective keyboard setting, whether the plate shall be passed or printed. These selections can be blanked out in the same way as printed matter. In the case of the Addressograph plate the selections are plugged in or inserted on the top of the plate by tabs, the action here being mechanical on the tripper principle. These selections require independent insertion and removal. (See Appendix 23).

The writer lays claim to being instrumental in the development of negative selection. It was found in practice that while positive selection, i.e. the selection of those plates with the desired tabs or embossed "pips" could be printed according to the setting in the selector keyboard, all others being skipped, the desideration sometimes was that these plates should be skipped and all others printed. By a reversal in the selecting mechanism the reverse result could readily be secured, and as a result negative selection is now incorporated in the standard machine.

r v. Lister.

Addressing machines are now supplied either for the simple operation of addressing or with the addition of a lister attachment for making lists of addresses. By a simple adjustment the machine is capable of operating either way, and spacing arranged by a rack device to suit the user's needs. In view of the low cost of the lister attachment /

attachment and the immense possibilities of this type of machine for office operations of various kinds, such as wage sheets, rent rolls, valuation rolls, etc., it is generally desirable to make provision for this feature. The combined use of a lister attachment and cut out pads whereby information unwanted in a particular list can be automatically eliminated, greatly extends the economic application of the addressing machine. The lister attachment actuates the spacing up of the paper and automatically stops the machine when the paper has been filled up. Where plates are being skipped the paper does not space up, so that the list is continuous. The cut out pads can be varied at will so that on other occasions any information on the plate can be brought into point according to the desire of the moment. Lister attachments of various types are now available, from which mention may be made of the multiple spacer and side by side lister. Other refinements include automatic paper feed from continuous roll and cutting off device.

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~~As a development of~~ Listing machines are now available which are capable of transferring different sections of information on the plate into two (or more) columns of a statement at one run. This is achieved by having an addressing machine with a double (or triple) head, each of /

of which may have a different cut out pad fitted. If the listing attachment has a column alternating device fitted, the machine will automatically carry out the process of filling in the different lines of information on the plates horizontally on a vertical statement in appropriate columns, spacing, selecting and stopping being entirely automatic. It will readily be realised from a perusal of Appendix No. 22 that the scope for such applications of addressing machinery is very considerable. A multiple head machine, while essentially slower in operation than a single head type, in accomplishing two (or more) operations in one run and one handling of plates and papers, and in giving perfect alignment, with one attendant, must be carefully considered in contrast with the speed of two or more single head machines which may in total be cheaper to purchase.

While it might be thought that the mechanical details of operation of a machine are not matters of concern to the user of office machinery, this is rarely so. It is almost impossible to divorce the principles of operation from the economic application of the machine. This may be illustrated from the two principles of plate or stencil feed in addressing machinery.

In the case of the back to front feed (Addressograph), for plates, the printing head is necessarily operating from the /

the side. If a sufficiently long side throw is not available in the machine, difficulties may be experienced in handling large size papers which are being entered up in extreme right hand columns. There is, however, the consideration that in back to front feed the oncoming plates are visible to the operator at the first feeding stage. In certain circumstances the operator may be required to carry out some visual selection according to a colour, marking, etc. A further objection to this type of feed is that the opportunities for the insertion of constant repetitive typescript (such as slogan, etc.) which is not required to change with the plates, are rather more limited, although a consecutive numbering and dating device to print to the right of the data on the plate is now available. In the case of the side feed of plates (Adrema), inasmuch as the printing head is here hinged at the back, the difficulty of handling large sheets of paper towards the bottom of the sheet may present considerable difficulty.

v. platen.

The use of roller platen (which makes a quarter revolution during printing) as a means for impression has undoubted advantages over flat platen for clarity of impression - a very important factor in the efficiency of this type of machinery - but it is doubtful whether this method is entirely successful for carbon copies. There is the /

the further advantage that the change of cut-out pad is a much simpler operation, and automatic selection of the appropriate cut-out pad can be brought into operation in a predetermined sequence. Imperfect impressions from flat platen machines are unfortunately not unknown, and this failing tends to be accentuated on the carbon copy.

The selection of office machines on sound lines almost always involves some consideration of the mechanics of construction.

of type - v. e.

The appropriate size of type used on plate machines is a matter which, it is felt, has not always received the attention it deserves. The distinction between pica and elite type is that where the former occupies a space of ten letters to the inch, the latter can accommodate twelve letters on the same space. Where a plate is strictly limited in size and the information to be inserted is extensive, the smaller (elite) type is desirable, since, in view of the cut out principle, specific information (such as names or addresses) cannot be permitted to overflow the space reserved for it. On the other hand, the greater the urgency for good carbon copies and the greater the number of these required from one operation, the larger type is to be preferred. In such a balance of considerations, the more important must take precedence over the /

the lesser.

ry v.
board
ossing.

As the embossing and amendment of plates constitutes a large part of the operation of such a plant, very careful investigation into the methods of carrying out this work must be made. Apart from stencils which are prepared on an ordinary typewriter (with ribbon out of action), plates are embossed by subjecting them to blows while under dies. The method of selection of the appropriate dies may be -

(a) on typewriter keyboard principle,

(b) by rotary wheel.

The typewriter keyboard principle requires little elaboration here, as it differs little from the manipulation of an ordinary standard typewriter keyboard. The embossing machine is, however, electrically operated, and the speed attainable is considerably less, as time must be allowed for the dies to engage and clear before the next can be brought into operation. Further, as the dies are in continuous rotation except when engaged in stamping, there is only "one way traffic". There is no reversing to pick up an anterior letter, and the actual printing is non-visible.

The rotary wheel principle functions in a somewhat different manner. Here the selection of the appropriate dies is done by a wheel, a pointer in a keyboard wheel coinciding /

coinciding with the movement of the dies. The actual die stamping operation is controlled by a pedal. The embossing of the plate is visible throughout. As reversing is as simple as forward movement, the travel of the dies is reduced to a minimum. It is extremely difficult to assess the respective merits of the two systems, as both are very efficient. Only an impartial time study could be regarded as a criterion of superiority, but it would appear that if the embossing is to be done by operators who are mainly employed as typists, the keyboard may have advantages. It is useful to observe, however, that -

(a) Embossing and addressing machinery must be considered as one unit, as plates of one make are not designed for use on machinery of another manufacture;

(b) Where selections are extensively used, the rotary embossing machine can emboss these while the keyboard embosser does not do this work;

(c) Even good typists have a preference for their work being visible.

ibility
lates.

The amendment of plates and stencils is undoubtedly an important operation in the use of addressing machinery, but before this can be done the desired plate has to be picked out and eventually returned to its appropriate place in the sequence. Anything, therefore, which can be done to facilitate this picking out and returning of plates - almost a continuous process - must influence the selection of /

of an appropriate type. Although much is made in sales circles of the readability of an inserted card index on the frame and plate type, it should be borne in mind that -

(a) The addition of a card index involves its insertion, removal for correction and re-insertion. This may add greatly to the work of running the system.

(b) The real need for this card index may be due partly to the fact that the embossed matter on the panel plate is available only in the obverse.

(c) There may be alternative methods for the ready location of plates without a card index.

Before, therefore, deciding on a system which obviously affords a satisfactory card index, it is well to consider whether the ready location of plates can be achieved by any other means less costly to run. Among the indexing devices found in practice are the following:-

(1) All plates bearing a serial number and partition plates inserted at stated intervals. Where additions to the system are almost at the end, this method may work quite well.

(2) Each drawer suitably labelled and tabbed plates or cards shewing broad divisions (e.g. street, grades of workers, etc.) readily visible. Search is narrowed to a limited number of plates.

(3) Staggered top edge painting conjoined with broad classification tabs, e.g. plate for say, 38 Montgomery Street -
(a) Find tray with Montgomery Street
(b) Look for tab Montgomery Street
(c) Pass first three tens, (small tabs) and take the plate with yellow edge in eighth division.

These /

These are but a few of the devices used for locating plates, and some time spent in devising means for this expeditious handling is well repaid. It may be mentioned that tabbing with the tabs supplied by the makers in no way interferes with the automatic selection when passing through the machine, but in the case of the Addressograph plate which depends for its automatic selection on inserted tabs (see supra), the possibilities of tabbing as an aid to selection of plates is limited to the non-automatic selection field, although addition of plates which are not to pass through the machine is not debarred. One-piece plates which have been amended are not, however, very readable, owing to traces of former print obscuring the new print.

In connection with the amendment of plates, it is important to adopt -

(a) A standard form for the notification of amendments which follows the standard plan of the plate;

(b) A regularised checking system which ensures that all amendments are duly made.

lusion.

The degree of permanency, legibility and automaticity which can be secured by the well planned use of addressing machinery is very considerable, and the many applications to routine work are not always realised. Straightforward addressing, preparation of statements, notices, reminders, hire purchase, rent and other records, collection, despatch and /

and delivery of goods by round sheets, the preparation of labels, consignment notes, invoices, come readily to mind. The maintenance of shareholder records, issue of dividend warrants and lists, income tax and superannuation returns, stock-keeping, inventories, stock cards, piece work tickets, time cards, production orders, wage sheets, personnel records, pay envelopes, advertising and customer cultivation - these are but some of the repetition jobs which call for something better, something faster, something infinitely more accurate than the best of clerks. By the combination of automatic and visual selection, repeat prints of particular plates, for example, can be introduced. The addition of stopper plates will automatically stop operations at selected subdivisions of the work. Again, the automatic prevention of attempting to print, say, a five-line plate when only four lines of the paper are left, is another example of the refinements possible with this machinery. In this country we may be said to be only at the beginning of a realisation of the potentialities of addressing machinery to accomplish economically, routine clerical work.

By reason of the fact that plates can be arranged (and re-arranged on a change of system) in any order desirable for the purpose in view, and keep this order no matter how /

how often used, there is security and permanency in the repetitive work, and an important control factor against the overlooking of a customer by any other department. Since corrections can be made on plates of only that portion requiring correction, a minimum amount of checking is involved, but, as plates are prepared for repeated use, and are corrected from time to time for further service, it is important that at initial preparation and subsequent amendment they are carefully checked. The chances of an ordinary clerical error being repeated time and time again are remote. Under an addressing machine system, the repetition of an overlooked error is a certainty.

As information on the plates can be combined with certain details common to all plates (such as date, advertising slogan, warning, etc.), there is very considerable scope for the application of this machinery for circulating standard messages to large voluntary forces, such as a local authority's Air Raid Precautions personnel.

In so far as the use of appropriate cut out pads can automatically eliminate any part of a plate not required for a specific purpose, the whole surface of a large composite purpose plate can be made use of economically. When combined with automatic selections, continuity for one purpose will not confound with selectivity for another, and /

and serial numbering in each case will be accurate and effective. While exact spacing is secured, by reason of the mechanics of operation, the appropriate use of automatic selections for variations in spacing for different purposes can be provided as the occasion demands. Warnings by automatic signal lights are provided on some machines where it is desirable that discretion should be applied to a situation which cannot readily be mechanised. The chief advantage of the modern addressing machine is its versatility to cope with much of the routine work of an office in a speedy and inexpensive way. So simple is it in operation that the most junior staff can be employed to work it. The work turned out is clear and legible, and in appearance equals good typewriting or duplicator work. Once plates or stencils have been carefully edited, the work the machine produces requires no further checking, no matter how complicated may be the purpose, and it is capable of handling peak loads of work often inseparable from business activity. The addressing machine owes its origin to the desire for relief from monotonous work. Its economic use requires the careful planning and precise thinking, especially wherever its proposed use goes beyond the simple addressing function. The correct positioning of information on the plate is everything for the cut out pads. The /

The best choice of selections is of supreme importance to the automaticity of operation. A well designed system of ensuring prompt and accurate amendments to plates is the most important factor in its satisfactory use.

Having considered separately accounting and addressing machinery, it is useful to review such machinery associated as a ~~single~~ combined unit. Its use on the work of issue of standard periodical accounts such as rates, gas and electricity affords a typical example. At the risk of repetition, it may be emphasised that where an extensive scale of mechanisation is under contemplation, the following considerations assume even greater significance.-

(a) Preparatory work in connection with the planning of documents of original entry to fit the mechanisation, e.g. planning and positioning of records, plates, forms; determination of order of routine operations.

(b) The use of types of machinery suitable for combination to produce a composite result, with special reference to the division of function between the machines.

(c) The simultaneous preparation of various records at one operation.

(d) The extent to which proving and control is simplified and checking is minimised by the use of machinery and by appropriate sectional balancing to localise differences.

(e) The use of codification with a view to saving of labour and reference numbers for tracing purposes.

(f) /

(f) The degree of accuracy and rate of output.

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Inasmuch as such periodical accounts arise with a relatively stable body of customers, the use of addressing machinery is eminently suitable for the written matter. Plates or stencils are prepared and filed in trays in the appropriate order required (which may be varied), amendments being made thereon as necessary from time to time. The plates may be prepared to contain more than mere names and addresses. Any stable information, reference, number, etc., may be incorporated and blanked out by the use of appropriate cut out pads where such information is not required to be reproduced. This involves the predetermined fixing of fields for all information put on plates. There is the further advantage that a "family of plates", the members of which can be differentiated automatically by selections, can be utilised where -

(a) information required to be inserted would otherwise overflow the restricted space or field allocated to this information. In this way the initial restriction of "field" can be overcome on occasion by the use of what is known as "follower" plates;

(b) special information is required in certain cases only. In this case a "selection" utilised for this purpose will select or pass over these supplementary plates in the family according to the needs of the occasion as expressed by the setting on the selection board.

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The trays themselves are the actual containers for loading the addressing machine, which, as it makes use of the addresses, again files them in an empty tray put there for subsequent removal. By the use of selections, certain addresses may be automatically selected or passed over, e.g. yearly accounts where quarterly accounts are the general rule. By the use of the addressing machinery, partly prepared demand notes in duplicate with address, etc., particulars repeated on receipt or office portion are got ready for the subsequent accounting operations. A decided advantage is that much work in the part preparation of demand notes may be undertaken (subject to some amendment later) in advance of actual requirements, and in this way peak loads of work on the machines are lessened.

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The actual accounting work is performed on billing machines of which there are several varieties available. A typical example is the Burroughs Public Utility machine on which quantity (cu.ft., therms, units, etc.) and value equivalent, classification (coded), are inserted. Cross adding or subtracting, and vertical adding of each bill and vertical adding of one bill with another is done automatically according to the pre-arranged setting on an actuating bar on the machine. This setting can be varied for /

for different runs of the machine.

In the course of completing this demand note the machine will automatically repeat the machine total on a stub for use as a receipt and also on an office stub for filing purposes if so designed. By the use of carbon paper the demand note may be prepared in duplicate, etc. A copy of each bill prepared may be inserted by carbon paper on a suitably spaced summary sheet which, according to the purpose for which it is required, may be the consumers' ledger, the sales book, etc. This summary sheet is fitted on the platen of the machine, and remains there, until full, spacing up for each fresh demand note. The demand notes are front fed and automatically released when the machine has reached the end of its cycle of operation. Totals accumulated in the machine under the various headings can be printed at the bottom of each summary sheet before its removal.

If a predetermined total of the documents of original entry has been taken, this will afford a reasonable guarantee of accuracy. It is useful, however, to introduce here a rapid check over to ensure that the appropriate entries have been put in the correct demand note. This automatically covers a check of the posted ledger, the receipt (when it matures into one), and the office stub. Postings in total for sections may be made to control cards /

cards by the same accounting machinery if there are any sub-divisions which it is desired should be compared from time to time.

The insertion of code references for various classifications of charges (an explanation of which is usually printed on the face of the form) procures this additional advantage that undue descriptive matter (always a retarding influence) is eliminated. At the same time complete information is given to the customer, and very often classified summations according tothe desired analysis is automatically furnished by the operation of the codifying key.

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Subsequent operations may be date perforating for discount, automatic folding and insertion in window envelopes, and subsequent postal franking. The diagram given in Appendix No. 12 shews the complete cycle of operations. Inasmuch as receipt stubs containing all the necessary information are prepared with the account, it is thereby ensured that the necessary particulars are available for posting of credits when the account is paid.

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minated.

The elimination of possible clerical errors at this stage will be regarded as not the least valuable feature of mechanical accounting by those acquainted with the time and trouble involved in tracing payments to their appropriate accounts in cases where imperfect particulars are /

are taken at the time of payment. It may be pointed out that in the illustration given in the appendix, the use of cash registers in the collection of the revenue arising from these mechanically prepared accounts blends admirably with the previous stages, in that the furnishing of receipts affords a detailed analysis of the revenue which, together with the outstanding accounts, should prove with the machine totals arrived at in the preparation stage.

The completeness of control may be indicated as follows:-

Section (which may be Valuation Book, Meter Reading District, etc.)

Predetermined total from documents of original entry	=	Mechanical total of Demand Notes as recorded in total on Summary Sheets.
Total Sections	=	Total Summary Sheets.

The use of appropriate section numbers on all documents pertaining to that section facilitates sorting, proving, analysis and filing, not only at the charge stage, but also at the discharge or credit stage.

Such a mechanised method of charging and collecting accounts calls for a measure of systematised recording of payments. A method usually adopted is that which is perhaps best known by the name of negative posting. The procedure is as follows:-

(1) /

(1) As payments are made, a receipt is given on the account and on receipt stub. This may be done by hand, by stamp, or as is usual (as in the illustration referred to above) by National Cash Register receipting machines which automatically detach the stub, receipt and accumulate (analytically) the amounts paid.

(2) The receipt stubs are then used for picking out of the outstanding accounts cabinets, the corresponding office copies. The picked out office copies are then added or listed in a machine and should agree with the predetermined total of the receipts given by the Cash Register. An orderly system of filing and an identification reference for pairing is also helpful.

(3) The receipt stubs are filed under date of receipt in support of cash book entry, while the office copies may be sorted back into customer, etc., numbers as a record of payments made by each individual where this is essential.

The same machinery can also be utilised for summing arrears (sectionally, if sectional balancing is the accepted principle) remaining unpaid at a certain date. If payments made are recorded by punchings on a roll the addressing machinery can be made to list or prepare second notices to only those remaining unpaid. Alternatively, a list and/or/final notice can be made from the stubs uncleared from the cabinets with or without the names and addresses, and agree sectionally with the predetermined figure arrived at as follows:-

Total charge - Receipts = Balance outstanding

= Total list of outstandings.

This list is also useful for adding the arrears to the next /

next periodical charge where this has now fallen due. The arrears brought forward must be added to the proved half-yearly charge in order to prove the accuracy of the demand notes. Where there is no new added charge to which arrears can be added, the arrears require to be repeated on a new term's form for the purpose of proving. The form so prepared can be used as a reminder or second notice.

The method adopted in the illustration given in Appendix No.   is even more simple. By the use of carbon copies, the second (i.e. final) notice is actually completed at the time of the preparation of the original account and is only detached from the office copy where this is required. In this way, reminders can be sent out on the day of balancing with a very considerable saving in delay and labour.

ided ective trol is rcised.

The importance of the function of the central figure, the proving or control clerk (see Appendix No. 12) cannot be over-emphasised as the careful daily recording by him ensures the efficiency of the whole accounting scheme. Either the billed accounts agree in sectional aggregate with the predetermined total for the section or a reconciliation is made before the accounts leave the office. Sometimes a cross proof is also possible, e.g. total consumpts as shewn in prepared accounts (known from accumulating /

accumulating register) multiplied by rate = charge for gas, as given by the predetermined total of original documents.

The correction of any errors found by the control clerk necessitates careful recording. This is usually achieved by adding the correct transaction, and thereafter deducting the incorrect posting. A similar control in the accounting for the revenue collected, and in the accounts outstanding is necessary to safeguard this essentially simple system.

The development of such a highly mechanised system involves considerable planning and preparatory work. Provided this is carefully done, it functions extremely well and effects economies, particularly in checking, proving and audit, and the maximum of routine work is placed where it can most effectively be performed, namely, on a machine.

icators. The term "duplicating" machine like that of "addressing machine" is somewhat of a misnomer. The derivation of the word would imply the production of a duplicate, whereas the term is usually applied to machines capable of manifolding, i.e. the reproduction of many copies.

Duplicating or reproducing machines are perhaps among the oldest of the modern office machines. Owing to their more obvious application to routine office work, their simplicity /

simplicity and cheapness in purchase and running, their use is very general to-day wherever numerous copies of the same document are required.

Broadly, it may be stated that normal typewriting production will give one original and six to twelve carbon copies at one operation, according to the quality of paper and the suitability of carbon paper. While on occasion it may be more economical to repeat the typing twice, it is true to say that if more than 20/25 copies of a document are required, it is advantageous to use a duplicator, as only the master copy requires checking. If more than 3/400 copies are required, printing normally becomes an economic proposition, provided there is time for awaiting the supply, and no question of utilising existing staff and plant arises.

Except in the case of certain methods of duplication, mentioned hereafter, the use of a duplicator involves the use of semi-absorbent paper. As this quality of paper has only limited uses for subsequent ink writing, consideration must be given to the uses to which the production is to be put.

Duplicators are of various types, hectographic, lithographic, photographic, typographic and stencilling, being the kinds most commonly met with.

Originally /

aph. Originally the hectograph principle in manifolding depended on the use of a jelly or clay and a copying ink. The master copy was prepared through a "copying" ribbon or otherwise produced with copying ink. The master copy was then placed, print side down, on the flat tray of jelly and left sufficiently long for a deposit to be left on the flat surface of the jelly. Thereafter copies could be pulled off the surface of the jelly by removing a small quantity of ink from the jelly image, on each sheet of paper applied to it until too faint a copy was obtained. The jelly face was then washed with tepid water and re-used until the tray required refilling. The whole operation was non-mechanical, very economical, but slow and messy. The principle has, however, been improved upon in the Fordigraph and Ormig mechanical duplicators which rely on a copyable master (which may be prepared by typewriter, carbon paper, or by hand with copying inks, in one or more colours) and a damping (but quick drying) liquid. The master copy requires to be converted into a "wrong way round" in order that the productions will be correct. This is achieved in different ways, either by using a carbon facing the type or by effecting a transfer on to the reproducing medium. When this has been done and the reproducing medium fixed on the drum, reproduction is by the normal rotary method.

The /

The particular advantages of the hectographic method are:-

(1) Use of paper which can be written on in ink - any weight or quality, hence durable copies where so required.

(2) Various colours can be reproduced at one operation.

(3) Little expert skill is required.

The only disadvantage is the limited number of copies obtainable (about 200) from one master.

A careful analysis of the average number of copies generally required should, however, be made, as it is rarely found that the copying capacity of duplicators is fully required.

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This method of duplication, on the offset printing principle, relies for its reproduction on the mechanical attraction of fats and their repulsion from water. If the greasy outline is drawn on a suitable surface, the outline uptakes fatty ink from an inking roller, while the rest of the surface, covered with a film of water, repels the ink. The "loaded" image is thus able through pressure to give the required reproductions which are of a particularly high quality. This type of machine will reproduce typewriting, handwriting, pen, pencil and brush drawings, with equal facility.

There /

There is also a lithographic process of reproduction which is based on the chemical reactions on specially prepared flexible metal plates - a form of photographic reproduction.

Among the advantages of this form of reproduction are the speed at which very large numbers of copies are obtainable from one litho, some 4000/5000 being produced in one hour. The process is, however, rather more expensive, and the preparation of the lithos, except in the simplest case of typewritten matter, cannot be done in the office. Where the larger number of copies is required on ordinary paper capable of being written on, this method of reproduction is worthy of serious consideration.

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oduction.

The principle applied here is that of preparing a negative and reproducing by the use of sensitised paper, exact copies or reduced fac-similes of documents. Each copy produced requires development and fixing. The versatility of this type is illustrated by the fact that copying can be done from an original of any kind, doublesided, loose or bound, transparent or opaque. In some cases no dark room is required. The copies are always complete in every detail even to corrections, and are accordingly accepted in a court of law. The process is, however, relatively/

relatively slow and expensive. The production of film photography in miniature for subsequent projection has recently been developed. The speed of photography is in the region of 3/4000 per hour, and as many as 2,300 documents 10 inches square can be accommodated on 100 feet of film. The film saves 99 per cent. of the storage space. While photo printing is an effective method of copying, it is hardly in the sphere of manifolding, and its application to office repetitive routine is prescribed.

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ing.

The normal office relies to-day mainly on the method of stencil copying, because this involves little expense or abnormal organisation. The purchase of a rotary duplicating machine, stencils, ink, and, usually, some absorbent paper, completes the equipment. The method is to prepare a stencil on an ordinary typewriter (with ribbon set aside). The type face punctures the face of the waxed stencil which is otherwise impervious to ink, then this is placed on a rotary duplicating machine (hand or power driven), and duplicating ink which is of considerable consistency is forced by slight pressure to percolate the stencil at the perforations made in the form of typewriting on to semi-absorbent paper automatically fed in by rollers. The operation is clean, speedy and simple, and up to 500 good copies are obtainable from one stencil. Speed and simplicity /

simplicity in working, automatic feeding of paper, an even distribution of ink, variable speed control, noiseless action and ease of adjustment, are some of the features of this type of machine. Comparatively low price, capacity for accommodating quarto, foolscap and brief sized (and larger) paper, and high quality of reproduction, commend themselves to business men, while the addition of features for counting copies, for automatic stopping when the predetermined number have been made, enhances the usefulness of the machine. A range of models to suit the most fastidious needs, has made the stencil machine an almost indispensable accessory in every office. Good cabinet arrangements for the convenient storage of paper and other supplies are usually provided as an integral part of the equipment.

There are many other devices for the rapid preparation of copies of office documents, ranging from the simplest office duplicator to the complete type setting printing machine. The determination of the appropriate principle to be applied and the model to be selected is largely a question of economics. Local printing costs, quantity and frequency of the duplicating, speed of production including all preparation involved, appearance and durability of the resulting copies, and the economical employment of existing staffs, are among the considerations which fall /

fall to be taken into account in any contemplation to employ duplicators in the office. But it must be borne in mind that there are decided administrative advantages in being able to have work of this nature done exactly at the time and in the way it is required.

There is another class of machine which caters for the copying of outgoing letters by a damping process, but the introduction of carbon copying has considerably limited the need for this type of office machine. These machines have been evolved since 1714, when a man named Mill filed a patent for an iron copying press. For over 150 years, letters were usually copied by a damp press process. The need for reliability and speed in spheres of larger scale production has brought into being the need for manifolding to an extent undreamed of fifty years ago. In consequence there has been evolved a variety of efficient machines to overtake such work in a variety of ways with a high degree of mechanical efficiency and with quantitative and qualitative distinctions which lend themselves to the varying needs of business enterprise with considerable economies in overhead expenses. The official responsible for the production of office records can only be certain that he is employing the most efficient method available for his particular purpose if he contrasts one system or method with another.

The /

ing and riting. The process of dictating and typewriting is inseparable from all but the most primitive or specialised of offices, and it is to be expected that the inventive genius of man should be directed to the production of mechanical aids to undertake this work in the most efficient way. The dictating machine, a mechanical device for recording the human voice, is really an adaptation of the phonograph and gramophone, with variations necessitated by the purpose in view. The equipment consists of -

(a) A dictating machine to which dictation is given;

(b) Transcribing machine from which dictated matter is obtained;

(c) Shaving machine for restoring cylinders for subsequent use;

(d) A supply of cylinders.

ating. The method of employing the dictating machine is extremely simple. It involves the plugging in of the machine to the electric main, placing a wax cylinder on a mandrel by inserting the fingers inside it so as not to damage the surface of the wax, setting the record carriage to the beginning of the cylinder (left), pulling a small lever to the dictate position. The speaking tube is then lifted from its hook and held so that the mouthpiece touches the upper lip. By pressing the control button on /

on the tube, the cylinder is rotated by the motor and the machine is now ready to record dictation. Enunciation should be regular and clear and in steady time. The control button should be released when ceasing to speak, otherwise a portion of the cylinder will be wasted. The dictate bar has three positions - dictate, which is down on the cylinder, neutral which is midway, and up for listening. The purpose of the dictate position has been explained. The neutral position is for inserting or removing the cylinder from the mandrel, while the listening position enables the dictator to go back on his work and check up on what he has already dictated, in order to confirm, correct or connect up his subsequent remarks.

By means of finger control indicator, the dictator can mark on a travelling scale for the benefit of the transcriber -

(a) Where a letter begins and ends. This enables the typist to insert in her machine the appropriate size of paper - quarto, foolscap, etc.

(b) Corrections, so that the transcriber can listen ahead to ascertain the correction before she types the first statement.

(c) Number of copies required - two, three, etc.

(d) Priority for typing by a pre-arranged code - A, B, C, etc.

Any particular punctuation (parenthesis, etc.) requires to be dictated to the machine, and the spelling out of difficult technical words may be necessary on occasion. When /

When the typing staff are experienced in the business, this will rarely be necessary. Provision is made in the equipment for passing to the typist the original correspondence for names and addresses, so that no more need be dictated in this way than to a shorthand-typist. When the cylinder transcribing is desired, set the dictate lever to neutral, remove by releasing the automatic lock, and press off with the ejector, put it into the carton, tear off the printed scale with corrections, etc., and send it through to the transcribing department with the cylinder. There is no need to wait until a cylinder has been completed before transcription, because its use can be resumed at any time, the place for resuming being clearly indicated by the remaining smooth surface on the face of the cylinder.

scription.

The operation of transcription is equally simple. The transcribing machine is plugged in to the electric mains and the reproducer lever is lifted up, the cylinder removed from the carton by putting two fingers inside the bore, and the cylinder slipped on to the mandrel of the transcriber as far as it will go. The printed scale is placed in the holder and the reproducer lever lowered at the beginning (left) of the cylinder, or such other point as may be indicated on the scale for resumed use, priority /

priority, etc. The headphones are then adjusted to the ears and the foot placed to operate the controls. The foot controls will cause the reproduction to begin and cease, and to back space as far as desired. Both hands are free for typing, which, after practice, can be continuous. Speed of reproduction, pitch of reproduction, and loudness and softness, can be adjusted by the transcriber. The removal of the cylinder from this machine is similar to that from the dictator.

ng. A full cylinder which has been reproduced and typed is then ready for shaving. This is done by an automatic machine which sets the knife for the correct depth of cut. This shaving process can be repeated about a hundred times, thus restoring the surface on each occasion for further dictation.

advantages mechanised tation and nscription

The advantages of this method of mechanical dictation are very considerable provided the system is economically applied. The elimination of the personal equation between the dictator and the shorthand writer, apart from psychological considerations, has an important effect in reducing the liability to overload one typist and not fully employ another. Work of transcribing can be better distributed. The quality of dictation is also vastly improved, through contact with the machine, not only in precision and cohesion of thought, but also in enunciation, with the consequent /

consequent result that errors are reduced. Even where errors are consciously made, the device available for their immediate notation minimises the possibility of their being included in the typescript. One of the main advantages of the dictating machine from the executive's point of view is that the ideas can be captured when they are hot, due to the continuous service of the machine. The dictator can accomplish his work, when he can and where he can, at his own speed, and with a degree of accuracy unsurpassed by even the best of shorthand writers. The inherent advantage of employing one person instead of two to undertake the work of dictating, thereby enabling typists to use their machines to the utmost capacity at their own speed, constitutes the major justification for the use of this equipment. An all day service for dictator and typist is no longer an ideal. The classical economists have always stressed the "leanning" element in the conception of a quantity of labour. With the use of a dictating machine equipment, there is no longer the need for the laborious acquisition of shorthand which is largely a means to the end of a typewritten document. This elimination of economic waste should appeal to educationists as well as to business men. The dictating machine takes the "l" out of "learning", and produces earlier "earning" capacity. The elimination of eye-strain on the part of the typist should also be borne in mind. In view of the fact /

fact that a single cylinder can accommodate 1000/2000 words, and, after shaving, can be used up to a hundred times, the saving in shorthand notebooks must also be taken into account. The sense of control which mechanical dictating fosters, the convenience to those whose time is the most expensive, would alone make the investigation of this method of dictating worthy of the serious consideration of most businesses.

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The very convenience and facility of the system is not without its dangers, however, and it is well to consider the following matters before being overtaken by the attractiveness of mechanical dictation and involved in a capital cost approaching £200 for a single installation.

First of all, an estimate should be made of the amount of dictated matter which could be reduced to the form of a standard "duplicated" letter, even with inserted variations. Secondly, consideration should be given to the experience and intelligence of the typists employed. Many of them are capable of replying to correspondence effectively by the mere indication of a yes or no. Thirdly, the nature of the predominant correspondence must be taken into account. If this takes the form of statistical matter which requires careful compilation and perhaps checking on a calculating machine before typing, it appears *prima facie* a case where the dictating machine would be of doubtful /

doubtful value. Lastly, if there is little or no concentration of correspondence in time or place, the numbers of fractionally used dictating machines might require to be considerable. Matters such as these ought to be weighed against the potential savings of mechanical dictation.

riting. Perhaps by reason of its relative age, or perhaps on account of its ubiquity, more scientific study has been applied to the efficient use of the typewriter than to any other office machine. It is not necessary here to recapitulate the work done by others in this connection, as certain extracts are given in Appendices Nos. 17 & 25. The intention is rather to approach the problem from the point of view of assisting in the selection of the appropriate kind of machine according to the main use in view, in order to ensure the greater efficiency in its application to particular office work.

It may well be that the typewriter, owing to the attractiveness of its general utility, has been taken too much for granted, and that too little attention has been given to the importance of special features in operating efficiency for certain types of work. As a corrective, it may be desirable to stress points of specialisation.

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As already pointed out in connection with accounting machinery, the main distinction between the flat-bed and platen style of typewriter is that, whereas in the former the machine /

machine is designed to move over the paper which is stationary, in the latter the printing point is stationary and the paper is made to move to this point. The features in operating efficiency are, however, of much more significance, and selection of the appropriate kind must depend on the nature and incidence of the work. While the flat-bed is claimed to be the only typewriter capable of typing on bound books, this feature is of much less significance to-day. The ease and accuracy which the flat-bed machine affords in the collation of documents of different sizes, thicknesses and shapes, is more important when the system is such that the "field" of common information on such divers records is considerable. An inductive study into the G.C.M. of typewritten matter on different documents would, it is suggested, afford a fruitful field for economy in almost any business. There is, however, another feature in typewriting efficiency which has not received the same attention devoted to the actual typewriting. That is the ratio of manipulation to actual typewriting. The insertion of carbon papers, trimming, positioning, and removal of carbons, may be of such an oft-recurring nature - particularly where forms are being used requiring only the insertion of limited information at various positions - that the minimisation of effort in this operation /

operation may be of greater importance than the actual typewriting itself. Owing to the constructional features of the flat bed typewriter, the possibilities of employing transverse carbons and back to front continuous rolls of forms whereby the removal of one set of forms brings into position the next set, should be carefully considered. Even when continuous carbons and forms are not appropriate, the rapid and correct alignment of different printing positions on forms of varying size may be a feature which suggests the use of this style of machine. Further, the predominance of typing matter on, say, the extreme bottom of a form, is readily accomplished on the flat-bed machine, as is also the typing of stiff index or ledger cards. The securing of several good carbon copies at one operation is also an advantage. The possibility of the continuous set up of different small forms on the same machine is also an advantage where the rapid production of different forms is bound by circumstances to be erratic. On the other hand, this type of machine is relatively heavy to manipulate, noisy in operation, and much less automatic in its features than the highly developed platen machine which is undoubtedly the generaly utility machine.

On the question of the relative merits of the single as opposed to the double keyboard machines (i.e. separate keys /

keys for capitals) there is some difference of opinion. The use of the double keyboard facilitates the rapid change from capital to ordinary lettering without the need for a distinctive selection of type. Probably if the use of capital letters is extensive there may be an advantage in this form of keyboard, but, inasmuch as it is an expansive keyboard, and use of capitals can be obtained from a single keyboard by the depression of the shift lock, it is doubtful whether a double keyboard has any superiority. Certainly the compactness of the single keyboard and its facile change to capitals has much to commend it.

tric non- ctric

The use of electric typewriters is not very extensive in this country, although a well known make has been on the market for over twelve years. The high degree of efficiency of the non-electric model may be partly to blame for this, but perhaps the main reason is that the cost of the electric as opposed to the non-electric model has not yet reached the level of appreciated marginal utility. The distinctive features of the electric model are that the motive power which drives forward the type bars is mechanical, being derived from a rubber covered roller which is driven by the electric motor, not the force expended by the typist on the keys. Accordingly, an adjusted level pressure of type upon the paper or stencil is always obtainable, as the force with which different letters /

letters and symbols must strike varies for different keys (e.g. "1" as contrasted with "B" or "8"). This amount of pressure can be regulated by altering the speed of the rotating roller according to the number of carbon copies required (as many as twenty good carbon copies can be made at one time) and the clashing of types during operation is entirely obviated. Further, the electric carriage return, electrically operated shift key, back spacer and automatic vertical spacing and underlining save time and energy. Key set tabulation is also incorporated. These machines can only be used electrically and are therefore not suitable where supply of current is not available either permanently or temporarily. Failure of power supply is fortunately a rare occurrence, but in an atmosphere of air raid precautions, one is entitled to ponder whether an organisation could contemplate the complete and protracted disorganisation of its typewriting department owing to dislocation of a power supply. Notwithstanding these considerations, the elimination of fatigue and the speeding up of this almost universal operation is a matter for serious study.

It may well be, however, that the greatest advances in the future do not lie in the mere electrification of the machine.

"In a recent lecture to an important group of business men in London, Mr F. Hutchinson of Birmingham, /

Birmingham, a well known business consultant, made the following remarks:-

> 'In a recent contest in London, for typing, the winner achieved a speed of 282 lines an hour, equivalent roughly, to 47 words a minute. It is very doubtful whether any company was obtaining an average output of 47 words a minute over a month. A study of numerous offices revealed the highest monthly output to be 26 words a minute. This is not an average, but the output of the fastest operator in the office with the highest average. The average was 17 words a minute amongst 22 typists. This was from transcription from a dictating machine. Where shorthand was used, the figure was between 4.8 and 7.4 words a minute. From this comparison between actual and potential output, it is apparent that much time, by some means, is wasted; not lack of application by the operator, but because of factors for which management was responsible; ineffective organisation, bottle necks, operations which had crept in, but which served no useful purpose!"

It is true that these probable defects in office organisation do not detract from the potentialities of the electric typewriter which, it is claimed, gives an increased output over its manually operated predecessor of 30 per cent., owing to lighter touch, shorter key depression and effortless operation. It may be observed that the electric typewriter is not, in its present stage of development, by any means silent.

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Where many ordinary typewriters are operated in the same room, as for example in the central typing pool of a large organisation, the resulting noise may be considerable /

considerable. Where dictation is given by a departmental telephone system this noise may be a great hindrance to efficiency. Fortunately much progress has been made in recent years in the development of silent typewriters. This relative silence has been achieved in a variety of ways ~~with~~ which need not concern us here. It may be pointed out that the isolation of noise producing machines in a silent chamber is rarely practicable, although arrangements have been made with one make of machine to enclose it during working in a glass fronted case. The use of machines that are as nearly noiseless as possible, at a cost little more than the ordinary models, is a true form of economy.

The chief types used in standard office typewriters are Pica, Medium Roman, Gothic and Elite. Pica type is found in approximately 90 per cent. of office typewriters. Medium Roman is slightly larger, but similar in character. Gothic type is often used in flat bed machines and others employed on invoice work. Elite type is found suitable for correspondence or tabulation work where it is necessary to get more characters into a space than is possible with pica. A somewhat more recent introduction is the pin point type which, owing to its construction, pierces the surface of the paper as a protection against alteration. This is often used on cheques.

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In Appendix No. 26 a comparison is made between a passage typed in Pica and Elite and printed matter. It will be realised that where it is convenient to use elite type (12 characters to one inch) as opposed to pica (10 characters to one inch), fewer lines, sheets, stencils, duplications, etc., will be involved in the course of a year's work, and the economies to a large organisation may cumulatively be considerable. The clear heading up of tabular statements may also be worthy of consideration.

le v. visible writing.

In straight typewriters (i.e. where the typewriter is not combined with adding, etc., mechanism) visibility of the typed matter is the general rule. In defence of the non-visible machine, it has been contended that the efficient typist does not require to see the results of her labours, but it is a psychological fact that an efficient operator reacts to an error by requiring confirmation of the mistake made, and further requires to see it for the necessary correction. It is a material advantage that the typed matter should be continuously visible, as errors are more likely to be detected and corrected in this way. A visible printing line also means quick and accurate insertion and alignment of forms, and it may be stated generally that all operators prefer complete visibility.

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Among the recent improvements in the mechanics of typewriting, one of the most significant has been the adoption of key set tabulation stops as contrasted with the setting on a bar normally located at the back of the platen. The setting of tabular stops on the bar involved a rather slow and awkward operation of positioning stops and testing the results before use. After use, these stops required removal or pushing down. With the keyboard method of tabulator setting, the simple depression of a key when the carriage is in the desired position sets the tabulator stop and the elimination of any or all stops is equally simple of achievement. The further advantage that the scale setting on the carriage is visible while setting the stops enables these to be selected with accuracy, no further trial being necessary. Where the incidence of tabular matter is frequent, this feature is of considerable value.

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tures.

There are many other features in typewriters which may add materially to operating efficiency in certain circumstances. Fractional vertical line spacing, adjustable key tension for varying touch and for copying or stencil work, removability and interchangeability of platen or keyboard, automatic double spacing of capitals, vertical tabulating and vertical and horizontal lining arrangements may be mentioned. The form of paper feed, accessibility for /

for cleaning and the absence of glare from the keyboard should also be borne in mind in making a selection from the many models now available.

The typewriter is fast advancing from its original conception of a simple instrument for producing the printed word, to an accounting machine of the first importance. Even to-day one finds it incorporated in a billing and ledger posting machine, a cross and vertical adding and invoicing machine. In teleprinting over long distances, in automatic coding and decoding, in its capacity for dealing in musical score and in any language with equal facility, its place in office mechanisation is a worthy one.

Already a machine working on the principle of a pianola is capable of reproducing automatically as many copies of a letter as may be required. Its further development in the future will be dealt with later, but even in its present stage as an instrument of smooth, easy, convenient, silent and efficient service in business enterprise, the typewriter has economic applications wherever ten or more words require to be put on paper. The clarity, speed, uniformity, and powers of reproduction of typewritten matter is obtainable from almost all the makes of modern machines, and harmonises with almost any system, but optimum results will only be obtained if attention is paid to -

(a) /

(a) the facilitative aspects of the work,
(b) adequate servicing of the machines,
(c) the selection of the kind appropriate to the work.

As regards (a) the most expensive factor in typewriting service is the typist's wages, not the cost of the typewriter. The typist and the typewriter combine to make the typewriting capacity. Apart from selecting the appropriate type of machine, therefore, anything which can be done to facilitate the work of typewriting will increase the capacity. The use of a dictaphone, as already mentioned, will considerably enlarge the time available for using the machine productively. The adoption of suitable copy holders of the line-a-time type, particularly where tabular matter is being prepared, is another aid of great significance.

With reference to (b) it must be remembered that the typewriter is a machine largely composed of moving parts, and needs proper and regular attention by way of cleaning and oiling. A principle of trading out machines after a certain number of years' constant use should be determined on after experience in the economies of their use has been gained. Typewriting capacity decreases with age, and repair bills increase with the lapse of years. A life of about five years is suggested from experience as being about the margin of profitability, but this will depend to some extent on the make selected, and on the intensity of the use /

use made of the machines.

When consideration is being given to (c), it must be appreciated that typewriters differ from each other. Some excel in a particular class of work, and others in another. It is important to understand the many for the appropriate selection of the few. Special features must be related to the incidence of their use over reasonable periods, and to the additional cost, if any, which their acquisition may involve. Marginal utility again is the deciding factor.

The main function of the cash register is the printing and issue of receipts to customers, the recording of the money to be accounted for, and the recording of the number of receipts of each kind given. This composite result is obtained in the normal course of giving a receipt. The cash register is equipped with a full £.s.d. keyboard, and, in addition, certain features are made to order according to individual requirements.. Such features embrace the facility for repeating the serial number of the account, the identification of the cashier giving the receipt, and the identification of the class of revenue recorded. This latter key also automatically operates the selective device to accumulate amounts of like classification. The automatic features of the electric machine are -

(a) /

(a) appending signature, date and serial number of receipt,
(b) accumulation of analysed amounts and numbers of transactions,
(c) providing a proof roll with printed analysed amounts.

The greater control over the receipt of cash by this method is considerable, inasmuch as the essential records and counters are not accessible to anyone except the possessor of the key - usually the audit official. There are various types of cash registers available. In some cases (e.g. shops) a numbered ticket showing the amount of purchase is ejected for the customer. In others a stub showing the amount, etc., of the receipt is cut off and deposited in a locked container for subsequent ledger posting. The cash register is essentially a specialised part of the office machinery and must be selected to dovetail in with the requirements of the major office installation.

Among the more recent innovations in mechanical recording is the portable ticket issuing machine. The use of numerically printed tickets for a multitude of purposes is long established.

The collection of fares constitutes a very important part of the operating of transport undertakings. Every other aspect of such an undertaking has benefitted from extensive mechanisation, but for many years the preprinted ticket /

ticket was the only recognised method of carrying out this routine operation. The inherent disadvantages of this method are -

(1) The many different kinds of tickets which require to be provided and stocked to meet the needs of the industry.

(2) The number of statistics which require to be worked out for the different classes of travel.

(3) The complications of daily check and audit.

(4) The cost of printing serially numbered tickets in each of the series.

As a consequence of the recognition of these disadvantages a compact, portable, automatic, ticket issuing machine has been evolved which prints and issues an easily readable, distinctive ticket from a roll of blank paper contained in a magazine, according to the setting of the machine.

The machine is, in essence, a self-inking rotary printer with a magazine for holding a roll of paper, variable recorders in three or more dimensions, a relatively fixed stamp, a series of individual meters giving class analyses up to nine separate totals, and a totaliser for all issues.

The variable recorders are:-

(a) Serial number - entirely automatic
(b) Range of fares up to 9 - dial actuated
(c) Classes of fares - ordinary, workmen, child, return, etc. - indicator setting
(d) Stage boarded - up to 99 - wheel adjusted.

The (relatively) fixed information comprises, name of /

of undertaking, date, route or service, time of issue, number of issuing machine.

The machine incorporates:-

(a) Individual meters for each of the nine fare values.
(b) Totaliser meter independently actuated but corresponding with the serial number.
(c) A separate meter which records all tickets of one particular class, e.g. returns.

The machine is strong, light ($3\frac{1}{2}$ lbs.), rust proof, and guaranteed for ten years. It is simple to operate and produces a ticket complete and legible, the paper being specially prepared for the quick drying ink. A safety device is provided on the roll of paper which warns the conductor of the approaching end of the roll. The insertion of a new one takes not more than ten seconds.

The general advantages of this system as applied to public transport are:-

(1) A saving of up to 60% on the cost of tickets as compared with preprinted tickets. The figures for Edinburgh Transport Undertaking may be taken as an example -

Preprinted tickets		£7,000
Blank Rolls	£2,000	
600 T.I.M. machines at a cost of £7,500 of which 10%	750	
Total cost		2,750
Annual Saving		£4,250 = 60%

This is exclusive of the cost and maintenance of the bell punches necessary to cancel preprinted tickets.

(2) /

(2) The elimination of huge stocks of preprinted tickets involving the maintenance of a ticket stock department and the laying out of much capital in such stocks.

(3) Simplified Waybills and inspection en route.

(4) Prevention of waste ticket stocks owing to changes in fares, routes, stages, etc.

(5) Economy in accountancy and audit, due to automatic records of statistics provided by the machine.

(6) Saving of man hours in issuing and receiving machines and tickets at commencement and termination of shifts of duty.

(7) Increased speed of issue (30%) due to machine, and no need for cancellation. This speeding up is important during peak traffic periods and reduces uncollected fares.

One disadvantage of this type of ticket is that the passenger is not advised from his ticket of the place where he should leave the car. In other words, the ticket as presented is not related to the fare paid in a way which is readily recognisable by the passenger without reference to the table of fares exhibited on the cars. The three methods usually followed in dealing with return tickets are;-

(a) to issue a no-value exchange ticket for a surrendered "return" ticket, thus precluding its further use;

(b) the issue of a value ticket to the passenger in exchange for his "return". The return counts as cash to the conductor and may be checked from the special "return" meter previously referred to;

(c) cancelling or defacing the return ticket.

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There is another type of ticket issuing machine which is non mobile, as it is electrically operated, but which relies for its very speedy operation on preprinted serially numbered tickets in rolls, and is suitable for use at theatres, cinemas and other such establishments where the range of tickets is rather more limited but the peak loads of ticket issuing are acute. By the operation of a key and lever, a required series of tickets up to five of any of the six denominations are automatically delivered on a counter which is designed for the handling of cash. All issues are recorded on irreversible tamper-proof recorders positively driven. A magazine for each denomination of ticket is provided on the machine, each magazine holding up to 4,000 tickets. The machine is capable of being locked against improper use, and has a meter for each denomination of ticket. The machine which is of robust design is made in various sizes, dealing with from one to six denominations, at prices ranging from 40 to 125 guineas, and may be operated in conjunction with change-giving machines. Other models are available, such as the protable machine, where the tickets (six varieties) are not automatically ejected.

There are also various sizes of coin operated ticket issuing, change giving and automatic vending types of machines /

machines which have become commonplace on railway platforms, at works canteens, etc. This type of machine is fully automatic by insertion of the appropriate coin or coins. Machines embodying such features are found in the Underground Railways of the London Passenger Transport Board. These not only print tickets from a plain roll of paper, but also give appropriate change from any denomination of coin inserted.

The economic applications of these types of machines are considerable. Wherever there are a number of tickets to be issued, involving cash and consequently questions of audit, the ticket-issuing machine has possibilities, because where the issue is relatively small the expense of printing tickets is relatively higher, while, in the case of large issues, the relatively smaller economies multiplied many times may be very great. To-day, ticket machines are rightly considered as essential to perfect control. The machines are speedy in operation and have proved their reliability in use.

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Protection against fraud depends to a very large extent on methods of organisation, accountancy and audit. The appropriate division of duties to make fraud impossible without collusion, the independent verification of balances, and a continuous close-up audit and supervision, are well established and accepted principles. In preventing the fraudulent /

fraudulent alteration of documents representing money, the employment of appropriate machinery (e.g. pin-point type face, protectograph) can be of considerable value in the ordinary routine of preparation, and, on occasion, with incidental labour saving. Such appliances embrace cheque writing and signing machines and cancelling machines.

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Inasmuch as a cheque is a Bill of Exchange drawn on a banker, payable on demand, it may be a very valuable document. In the hands of a fraudulent person, it can often be made more valuable. Its protection may be of much more significance than the locking up of the safe at night. The history of cheques is, therefore, really a history of their protection. It is not generally known that the crossing on a cheque, //, is really all that remains of the drawing of the four walls of the bank on the face of the cheque to indicate that it must be dealt with solely within the walls of the bank, and was not therefore payable over the counter. The addition of the name of the bank names the particular four walls and constitutes a special crossing. The next stage was the addition of such words as "not over ten pounds", or some such limiting phrase. With the invention of chemicals for the erasure of such limitations, however, the protection thus afforded is not by any means secure. The use of specially manufactured, tinted cheque paper has made the forger's work difficult, but /

but it has been found that all surface impressions are removable by appropriate treatment.

The modern method of protection is to force an imprint of the amount of the cheque by breaking through or shredding the fibres of the paper, either in one or two colours of acid proof ink, in addition to the usual crossings similarly impressed. In some cases cheques are prepared on typewriters with pin point type which perforates the surface of the paper. It is now practical to ally processes formerly done separately, i.e. to prepare at one and the same operation the cheque, the office copy, list of cheques for banker, committee schedule, and even the postage list and cash book. A special device fitted to the typewriter ensures appropriate aligning and spacing. One type of protecting machine actually saves time by shredding a complete word at a time on the cheque. A speed of 3/400 cheques per hour can be attained in this way. The ineradicability of values, crossings and limiting clauses, the efficient, accurate and reliable operation of the machine, and its relatively low cost compared with the value of its service, makes this protecting device one which a business using cheques, dividend warrants, etc., to any extent may find indispensable on the same economic grounds as insurance. A high speed model prints the whole amount in /

in one operation in figures only. A speed of 6/700 cheques per hour (or in the case of repeats - 1,000) can be obtained on this machine.

A well-known judge in the course of proceedings in a Liverpool Bank case remarked - "It is the duty of the "public so to draw cheques as not to expose bankers to "risk through subsequent alterations." It behoves all senders of cheques to ensure that their cheques cannot be altered, by taking what may be regarded as the very simple precaution of procuring a machine which costs something under £20, is portable, and can be taken from place to place when required. The machine can also be designed to suit any monetary system. There are, however, improvements possible on this machine which will be dealt with later.

An electrically operated cheque-signing machine which prints a facsimile signature with protective background in two appropriate colours has now taken a recognised place on the market. This machine works on a rotary principle with endless belts which convey the cheques forward to printing position and eject them after signing. The impressions are given by two differently coloured ribbons. Equipped with a meter which can be read before and after using, a record can be kept of the numbers of cheques issued for signing and returned after completion. The machine /

machine is so designed that it will not operate unless and until the two switch keys are in position, and this is a safeguard against its improper use, as these two keys may be kept by two separate responsible officials who sign the meter register.

The signature can be printed at a rate of about 3,000 per hour with one or two signatures, and this effects a considerable saving in the time of highly paid executives and affords relief from a tedious and time absorbing yet important task. Further, the machines facilitate the dealing with peak loads of cheque and warrant signing which often arise after a company meeting.

There are, however, certain difficulties in the use of this machine. In the first place, the use of cheques in a creased form is fatal to the efficient working of the machine, and, secondly, the feed arrangements are so delicate that great care requires to be exercised in the quality (thickness) of the paper used. The machine has, therefore, not been developed for cheque endorsing, as these may come in on different qualities of paper and much folded. With improvement, however, the machine may be expected to extend its usefulness. A bank guarantee is, moreover, required in view of the definition of a cheque, viz. - "An unconditional order in writing, signed by the person "giving it ....."

The /

Cancelling machines to prevent the further circulation of paid cheques, refundment orders, tickets and similar instruments, have been in use for a long time. There are cases where such cancellation must be done individually, for example, tickets to be retained by passengers or patrons in a theatre, in which case some form of mutilation or punch is generally used. There are, however, cases where cancellation can be accomplished in bulk, and for this purpose simple but effective machines have been designed. The older method was to have separate cancellation stamping of each document, but perforation has been found to be more effective and cheaper, inasmuch as alteration of cancellation is practically impossible, and a considerable number of documents can be dealt with at one time, with a consequent saving of time. Treadle or power can be employed, thus leaving the hands free for manipulation of documents.

The following figures taken from the London Bankers Clearing House returns are indicative of the importance of devices for dealing with cheques in trade and industry to-day:-

Year	Value in millions
1900	£ 8,960
1910	£14,659
1913	£16,436
1923	£36,628
1927	£39,825
1932	£32,112
1935	£37,560
1936	£40,617
1937	£42,686

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While the use of self-recording instruments in the manufacturing processes of industry is outwith the scope of this treatise, nevertheless it may be stated that routine clerical operations are greatly assisted by the regular availability of accurate records of industrial processes. Such records in many cases obviate the need for complicated statistics designed to furnish the answers which self recording instruments so readily afford. The first essential for the control of a situation is to be aware of it, and the use of continuous recording instruments is beneficial in the securing of the optimum efficiency in and constancy of working conditions, without the collection of facts as a means to an end. Some typical examples of the utility of such instruments from the point of view of the management may be noted:-

(a) Control of combustion conditions to minimise the loss of waste heat. If too little air is allowed, there is incomplete combustion with consequent smoke. If too much air is given, heat is wasted in raising the temperature of the surplus air which passes out into the flue.

(b) Control of reacting liquids. - In certain chemical processes, efficient working consists in ensuring the passage of correct amounts of reacting liquids. Special types of recording liquid flow meters, calibrated according to the appropriate ratios and constructed to resist the corrosive action to which they are subjected, are available, which are capable of self correction for varying temperatures.

(c) /

(c) Recording calorimeters. - Statutory regulation requires the determination of the commercial value of gas according to the amount of heat supplied, and self-recording instruments now furnish a continuous record of this function.

(d) Gaseous composition. - The content of various elements in a complex gas may also be recorded on specially designed instruments.

(e) Density, pressure and temperature recording are generally known, and call for no special comment.

(f) Vehicle time and distance recorder recording the time and mileage of vehicles in motion or stationary.

It may be emphasised, however, that the various types of recording instruments here referred to have one factor in common. They produce a mechanically inscribed record, usually correlated with the time factor, of the variation of some one or more property or function. They are essentially "ex post facto" instruments, recording what has happened in the past and thereby indicating what will, in the absence of disturbing causes, happen in the future. If such happenings are not in accord with the scheme of things, then it is the business of the management to effect alterations in the circumstances of operation so as to bring the result nearer to the desired optimum.

The charts afforded by such instruments are produced promptly without labour, accurately without the introduction of the human element, and in the form required. They must, however, be -

(a) /

(a) studied in the light of the conditions prevailing at the time;

(b) interpreted, mutatis mutando, according to the alterations in conditions suggested by such records.

The application of machinery to any purpose presupposes a desire for better results, and, accordingly, it is not a matter of mere academic interest to know whether these better results are being attained.

The number and variety of self-recording instruments in industry are legion and their numbers are increasing. The power plant engineer is supplied with valuable data which there is little need to verify, thanks to the inventiveness of self-recording machines. The combustion efficiency, the suspension sediment or salts in solution is told him, not by casual observation, but by scientific measurement, and it is no reflection on his ability that he cannot rely upon his powers of observation only. We find instruments for making a continuous record in permanent form at each important point in the whole series of operations in power generation. Power plant efficiency in the abstract would have little meaning, as it is the resultant average of the efficiencies of all contributory factors.

Appendix 27 gives an indication how self-recording instruments may yet come to perform clerical operations.

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ices.

Probably the earliest case of putting a problem to a mechanical device and reading the answer is found in the visible weigher or self-indicating scale. The following extract /

extract from the "note books" of Leonardo da Vinci (1452 - 1519) is of interest:-

> "This method of weighing is very rapid, seeing that the plumb line shows instantly the true weight of the goods by touching the letter of the chart and does away with the worry and confusion which those endure who have to weigh when selling goods retail; that is to say, the trouble of trying so many weights, removing one, testing with the other, and never finding the actual weight of the goods. On the other hand, with this device, as tested by experiment, you can read straightway the figure on the chart which is touched by the indicator thread and you will know the true weight exactly...."

As regards the office, we have few, if any, fully automatic self-recording devices which are a direct outcome of prevailing conditions. But we are drawing very near to the day when a prompt historical record, as a by-product of a primary operation, will be available. The production of automatically selected lists now given by addressing plant, the automatic sorting and counting and recording of coins, the dial recording of postal frankers and the time recording instruments of to-day, are very near approaches to this ideal. But the fact that progress is being made in adjusting the various functional operations of the office to a machine basis, makes it appear possible that self recording instruments will yet take their proper share in the mechanisation of office routine. It is perhaps in connection with the "punched card" art to which the next chapter is devoted that we may look for development /

development on these lines. The essential feature of self recording devices is that they take up none of your time, yet do valuable work for you. Provided, then, that a punched card can be produced as a by-product of a primary and essential operation, the economic possibilities of this system are enormous.

essive ping, ering time- rding.

The varieties of repetitive work in office routine are legion. Sometimes it is found that recording is necessary where variations occur in one, two or more dimensions. Sometimes the recording is even more simple - that of repeating one single imprint on various documents. But whatever the precise nature, if there is a predominant repetitive element in the work, and it is of sufficient volume, there is prima facie a case for an investigation into the possibilities of mechanisation.

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Number- g chines.

As an example of variation in one dimension, the function of serially numbering documents may be cited. This variable factor may or may not be combined with some constant or relatively constant fact, such as a date, slogan, etc. Numbering machines, of which there are many makes on the market, all follow more or less similar principles of construction, namely, that of actuating revolving number dies by the back stroke, the actual printing being achieved by the down or forward stroke. Numbering stamps make clear /

clear impressions, and may be set to give multiple impressions of the same number up to infinity. Automatic inking of the dies is achieved by allowing the face of the dies to come into contact with an inked pad at the conclusion of the stroke and after the new number has, by the back stroke, been brought into position. The stamps may be reset simply by disengaging the ratchet when the circular dies are in a state of free wheel, and may be moved forward or back. Numbering up to six to eight figures is usual in various sizes of figures, but prefixes can be added by substituting a suitable die for one of the numbering wheels, e.g. 638972 or A38972. So many records are kept numerically, and so many could more effectively be kept in this way, that automatic numbering has been incorporated as a standard feature in many of the office machines primarily designed for other functions. It may further be pointed out that the purchase of serially numbered documents is not always an economic proposition. Such a procedure has also the disadvantage of causing a certain measure of disturbance to the normal flow of documents. Numbering machines are quite inexpensive, reliable, speedy in operation, and give perfect legibility.

Postal anker. Another important type of machine in this class is the Postal Franker which has very largely replaced the earlier /

earlier stamp affixing machine (except perhaps in the matter of stamping of insurance cards). As its name implies, this machine is designed to make a frank or impression on letters, labels for parcels, wrappers, etc., for subsequent posting. The function of stamping letters for post has for long been regarded as a routine job, usually relegated to the office boy or the least experienced of the office staff. Unfortunately, the very nature of this work is such that peak loads are apt to occur at certain times of the day, and the volume of the work may be considerable. The use of a postal franker is a great saver of labour on this routine work, particularly when an electric model is installed. There are other advantages of a most important nature from the economic point of view, and a brief explanation of the system may not be out of place. First of all, each user must be licensed by the Post Office, and a deposit made to account of postages. A number is allocated to the licensee and this number is incorporated in all impressions made by the machine. The credit value is obtained at the nearest convenient Post Office in less time than it would take to purchase stamps, by setting the meter to the value prepaid in units of ½d., and this value may be expended in any of the franking values - ½d, 1d, 1½d, 2d, etc. (up to, in some cases, 29/11½d). When the amount prepaid is exhausted, credit /

credit may be renewed. A $1\frac{1}{2}$d franking takes up three units. Pads of forms are supplied by the Post Office for recording credits and debits on the meter. This meter is visible all the time. In the machine is a rotary stamping device for frank values, advertising or other slogan, and a date and place cancellation die. The date is readily alterable each morning, and the slogan may be changed at will, provided the necessary electros have been made for the machine. In the case of the electric model, letters, labels, etc., requiring franking are fed into the machine practically as quickly as they can be handled, and the electric motor drives a feeding belt which simultaneously carries the document through the stamping dies which are also rotating. The franked documents are neatly stacked at the other side of the machine. Inking is automatic, provided the reservoir is kept supplied with the special red ink supplied with the machine. In hand models the rotary drive is supplied by a crank handle, while the electric model can also be hand operated in the event of failure of the electricity supply. In the operation of one type of electric franker, no value can be expended unless and until a document is in the franking position of the machine to receive it. This is an important feature for two reasons. First of all, no money can be wasted by the machine, because even if the franking has been done in error, a reclaim (subject to a small discount) will be admitted /

admitted by the Post Office if the document is produced at the time of the claim. Secondly, as the value of each impression impressed on documents is automatically registered in the totaliser, shewing expenditure (the credit meter shewing the balance still available), such expenditure can be checked at any moment from the last reading of the meter. The setting of the appropriate value for franking purpose is done from a small keyboard, and is changeable in a fraction of a second. Very bulky packages are usually dealt with by franked adhesive label.

The main advantages of this system may be summarised as follows:-

(1) Very considerable saving of labour. Hand operated models are four or five times faster than sticking on of stamps, while electric models are still faster.

(2) Purchase of stamping value of large amounts is very much quicker than the purchase of stamps.

(3) There is no possibility of the local Post Office being short of the values required, an occurrence which might cause considerable delay to the organisation.

(4) As each impression bears the registration number of the licensee, there is no negotiability of the firm's money.

(5) Coping with peak loads of work in preparing letters for post is greatly facilitated.

(6) There is less work in auditing stamp expenditure and little need to keep the usual postage book.

(7) Prepayment of postages by cheque eliminates the need for petty cash for postages.

(8) /

(8) The cheap publicity which the use of a slogan gives is a valuable feature of the system.

(9) The fact that franking involves automatic cancellation enables the mail to go direct to sorting stage in the post office, thus enabling it to be delivered earlier.

This formidable range of advantages might suggest that there is little left to be desired in such a system. There are, however, certain disadvantages. First of all, letters, etc., franked in this way cannot be dropped into any pillar box in the usual way, but must be handed over the counter of the Post Office at which the machine is licensed. This necessitates its use only during Post Office hours. Secondly, the machine cannot be used for enclosing a stamped addressed envelope for reply. This second disadvantage is now met by another type of Post Office licence, the reply-paid licence, whereby no stamp is necessary, payment being made by licensee only on used envelopes, post cards, etc.

Just as automatic numbering may be combined with some other operation, so franking may be combined with letter sealing. High speed machines of this type, capable of franking, post-marking and sealing letters at a speed of 250/300 per minute, are now available. Efficient, accurate, quiet running and easy to operate, the postal franker is one of the most important developments in office mechanisation.

Mechanical /

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Mechanical recording in two variable dimensions involves much more complicated machinery. In this classification an important type is that of the automatic time recorder - important because of its very general application and also because its main function is to save, or at least to safeguard, expenditure on what is generally the most expensive item in production or distribution, viz., labour.

In the problem of time recording, the one variable is the time, and the other is the individual. To bring these two into correlation, several devices are available, and these may be considered under four categories, viz., autograph, card, elapsed and radial types. The simple time stamp in the form of a rubber clock face with automatically rotating hands may be regarded as belonging to the previous category of one dimensional variation.

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The autograph recorder is simply a roll of paper exposed in the form of a slot for the insertion of a signature, each entry necessitating the movement of the paper by use of a lever and the stamping of the time on the paper at the same operation. While this type of machine is cheap, simple and reliable, and does safeguard the "time" for which an employer has to pay, it rarely presents the records in a form suitable for ready use. The names and times require to be sorted out or transferred to some other record before use can be made of the information /

information so recorded. The device has, however, one advantage that it can be applied no matter how many employees are engaged and transcription can be done from a roll in the negative sense, with great savings of labour. For example, the time recorded by all entrants to the works before starting time needs no recording, if only late-comers and absentees are noted. Similarly for all the other "clockings". In this way, very long stretches of the roll can readily be disposed of. But this method is apt to cause congestion in large offices, and is not well favoured by large employers. Key stamping instead of signatures may be used on this type of machine. It is not unknown for the paper roll to become torn or cut, thereby throwing the time recording out of gear for all who have to follow.

rders.

Card time recorders are designed to segregate the time impressions for each employee on to an individual card. This is achieved by each employee inserting his own card in the clock and making the impression by lever in the appropriate line of the card. An arrangement of racks for cards clocked and non clocked at the time office, draws attention to absentees, while the individual form of record is much more suitable for subsequent extension into wage records. By a process of automatic guillotining of the edge of the card each time it is inserted, the correct positioning of the stampings for each entry is ensured.

On /

On this , as on the previous machine, "regular" times may be shown in blue, and "irregular" times automatically recorded in red according to the setting in the clock. Within the limits of congestion, one clock may be used to effect the recording for any number of workers.

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With the elapsed time recorder, the actual period of time elapsed between recordings is stamped on to the card or form, thus obviating the necessity of calculations.

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The radial recorder carries a time sheet on a drum inside the clock, and to each worker is allotted a number. As the workman brings round the punch to record his time in the hole numbered with his number, he automatically brings his time record inside the clock into the position to receive the appropriate stamping. In this way his time record is aggregated on one place on the sheet, thus obviating the need for sorting out the clockings. The actual time sheet recorded by the workman can then be incorporated in the paybill. Here also by a system of different colour of ribbons coming into operation at certain times of the day, all late time, overtime, and irregular matters are forcibly brought to notice. There is much to be said for this type of time recording, one feature to its credit being that the time record is never available /

available to the workman, and there is, therefore, no possibility of its being altered. There is, however, an important disadvantage in that only the specific number of employees for which it has been designed can use the clock (maximum number usually 150), an additional clock being necessary for employees over this number. When different shifts are coming on or going off at the same time, special arrangements may have to be made.

The economic justification for the use of machines for keeping track of the time of each employee hardly requires emphasis as one of the main items in the cost of production. Much of office routine is concerned with this factor, and the clock is a well established measurer of time. That it can be impressed into service as a recording instrument also, has been recognised for a considerable period. But within recent years, the needs of various undertakings have been specially studied and catered for in a way which enables mechanical time recording to be harmonised with almost any mechanised office routine. As regards the office itself, the material cost of an office operation is usually a "scrap of paper", but the wages element may be considerable. Tardiness and irregularity have a habit of growing, and individual irregularity assumes a greater significance where mechanisation is involved. Nothing has been found superior to a time clock, although /

although it may also be necessary to supplant this device by discipline in insisting that employees who have clocked in, proceed at once to their allotted task. It is a recognised fact that good time keeping and good discipline usually go hand in hand. There is only one method of stopping bad time keeping, and that is to make it unprofitable, and the self indictment of a time clock causes little or no resentment in the minds of employees, and no grounds for dispute as the self prepared records are a model of clearness. The use of a different coloured ribbon for "lates" and overtime has a two fold effect. Firstly, it enhances the accuracy of the records which is always an economy, and, secondly, it obviates any expenditure of valuable moments in scrutinising any times within the scope of the normal. As normal clockings constitute by far the greatest number, the savings to the office may be very considerable, and no time is wasted in providing accurate office records.

Time clocks may be automatically corrected electrically from a master clock.

The selection of the appropriate type of time recorder will depend on several circumstances. The time recording requirements of various businesses vary considerably in quantity and intensity. Fortunately, the choice of machines is adequate to the occasion, and the costs are not /

not excessive when regard is had to the safeguards they ensure. Some of the considerations in the choice of the appropriate type may be noted:-

(a) Variability in number of employees. Card machines will be found advantageous, as one or more machines is capable of dealing with a greater or fewer number of employees. On the other hand, if there is considerable constancy in the number and personnel of employees, and there are other records involved which are kept in a standard order, (e.g. superannuation, Income Tax, etc.) the standard order of the radial type obviates any sorting.

(b) Peak loads. If there is considerable congestion at the clocks, the autograph method will be ruled out of count. Further, if the number of employees is very large, the tedium and aggregate time involved in posting the tape from an autograph or key recorder, makes this method less economic, although it may be noted that the tape can be removed after each clocking, and thus kept up to date.

(c) Flexibility or order required. Whereas the radial type emphasises a standard order, the card principle lends itself to sorting into a variable order according to the requirements of the occasion. Where job costing is indulged in, this may be an overruling advantage.

(d) Preservation and storage. Cards take up rather more storage accommodation, but have the further advantage that after other purposes have been served, the time record for each employee can be kept together and superannuation, Income Tax, and other records for each may be facilitated.

It has been said that no one can cheat Father Time, but it may be noted that there are tricks known which make mechanical /

mechanical time recording fallible, but these are of relatively minor importance compared with the faithful yet equitable service of automatic time recorders.

In the sphere of certain simple manipulative processes, such as sorting, mechanisation reaches at once its highest and its most disappointing levels. There is a great variety of machines ranging from the single function appliance to the highly developed punched card sorting machine. But there is much manipulative work in the office for which there is at present little prospect of help from mechanisation, except in the very largest of establishments, such as the Post Office. There are, however, numerous accessories which are worthy of mention before passing to a rather more detailed consideration of the punched card system.

The problem of opening incoming mail has been generally simplified by an automatically fed, electrically or hand operated slitting device, capable of opening 200-500 letters per minute. This machine renders the removal of the contents easy, but is incapable of taking out the contents, a process which must still be done by hand. Hand and electric machines for the converse process of sealing letters are also available in various designs, one at least of which is stated to be capable of dealing with /

with 20,000 envelopes per hour and is accordingly a material help with an operation which almost inevitably has a peak load at the end of the day. Catching the post is so often a race against time, and time is usually money. The operation of sealing may also be combined with franking of letters, while self sealing envelopes are also available which greatly minimise this work without mechanical aid.

Before the sealing operation can be performed, however, there is usually the problem of getting the contents into the window envelopes, so generally used owing to their labour eliminating features. A folding machine is indispensable where the volume of work justifies its cost. The best type of folding machine is an electrically driven machine which automatically feeds itself and is rapidly capable, by easy settings, of adjustment to accommodate a variety of manners of folding. The machine stacks the folded documents ready for putting into (window) envelopes, counting the documents at the same time, from eight to twenty-five times faster and more accurately than can be done by hand. There are, of course, (generous) limits to the size of documents which can be folded by an office machine. Many documents can be purchased already folded by the printer at the time of printing, thereby eliminating the need for a folding machine. Before taking this step, however, regard should be had to the office procedure with the /

the form, as much machine and office time may be wasted in opening up forms for the insertion of particulars. Where the forms are quickly and economically produced on some fast office machine such as an electric duplicator, pre-folding would be out of the question. There may be considerable advantage from such speedy machines if valuable time is later to be wasted in the tedious, routine, slow and expensive folding of papers by hand. The modern machine requires little or no upkeep and is extremely reliable and accurate in its folds, a matter of some importance where window envelopes are used. Provided there is an adequate load, such a machine is a source of very real and continuous economy, even on the basis of an hour's work per day up to 10,000 accurately folded sheets per hour can be obtained.

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The handling of considerable quantities of coin coming in and going out has been greatly reduced by the development of the cheque system. It was estimated that the value of cheques passing through the London clearing house last year (1937) was £42,686,000,000, and the trend (p.220) indicates that this sum will grow. Notwithstanding this development, the progressive growth in the size of the business unit and the centralisation of cash functions in head offices, has tended to increase the amounts of cash to be handled in certain quarters. Wages in this country are still almost invariably paid in cash. When large sums of money have to be regularly counted and made up into wages, a set of coin counting /

counting machines can give great economies.

The electrical coin sorter and counter will take a quantity of mixed silver, and by a process of agitation or riddling, will segregate the coins of each denomination quite automatically, stack them or bag them, and at the same time, rapidly and accurately, tally the numbers under each denomination. There is some noise in the operation of the machines, and they will not detect damaged or counterfeit coins. As the labour of counting money by hand is tedious and confers no particular advantage on any individual performing the operation, except a miser, the application of machinery to this work is desirable. Owing to the circumstances of time-keeping, the making up of wages is a job which must usually be compressed into a very limited time, involving the drafting into the pay department of additional assistance for that short period. Any device which enables the regular staff to cope with these peak loads is an administrative advantage. A machine will count from 700 to 1,000 coins a minute or £100 mixed silver in five minutes, with greater accuracy than a skilled employee. Indeed, so accurate are these machines regarded by banks, that one count is considered as sufficient, whereas hand counted money is usually cross checked.

There are also available, copper counting machines particularly useful for tramway undertakings, slot machine proprietors, etc. These machines are capable of counting

30/- worth per minute. A portable model is also available.

g.

The automatic change giving machine is a device to save the time of a cashier in giving change. A magazine or till is provided which holds a quantity of coins of each denomination required. The coins are in columns, and provision is made to push out, by pressing the appropriate keys, of which there are 120, one or more of the bottom coins. As these machines deal with two known factors, viz. the money tendered and the value of the purchase made, the calculation and delivery of change is automatic, subject to the pressure of the correct keys. For example, if 10/- has been tendered for a purchase of 4/8, a moving bar set to 10/- and key marked 4/8 depressed, will ensure the delivery of change to the value of 5/4. The operation takes about one second. Automatic mechanism causes the machine to be come inoperative if any of the required coins are missing, so that machine mistakes are impossible. The saving of time and guarantee of accuracy relieves a harassed cashier of much worry and fatigue as well as safeguards the money of the employer.

paying
ines.

A machine which is built on similar principles is the automatic cashier, often referred to in advertisements as "A Paying Concern". This is also provided with a keyboard of 120 keys and magazines for holding coins. Each key connects with fingers gauged to 1/100th of an inch which deliver /

deliver the exact amount marked on the key in operation. If a key marked 9/7 is depressed, the machine will release this amount (two half-crowns, 2 florins, one sixpence and one penny) and deliver at the mouthpiece with practically fool-proof accuracy. The keys are conveniently arranged for rapid and accurate selection and can be operated by anyone capable of reading figures. The operator's attention is concentrated on one key at a time, and with a simple movement of one finger he completes a complex delivery up to 9/11. Provision is also made in this machine for a locking device coming into operation when any magazine becomes empty. One machine will hold from £30 to £40 in silver, and a reserve storage tray will take another £70. As already noticed, the making up of wages is usually concentrated on a particular day or days of the week, and a machine which expedites this work while ensuring accuracy is very desirable, enabling a cheaper class of labour to be employed on the work. The employment of a witness to check and packet cash can be arranged for if desired. The machine does not displace the wages staff, but it affords an aid to speed and accuracy far beyond the power of human head and hand, and much of the strain of cash handling and counting is eliminated. The economy and certainty of the single movement involved in operating the machine needs only to be contrasted with the mental and physical exertion in counting /

counting out and collating the same amount by hand for the benefit of mechanisation to be immediately apparent. Already over 55,000 firms are using automatic cashiers. A marked feature of this machine is that its introduction involves no change in existing arrangements for the making up of wages. These machines are coin machines, and so far no machine has yet been devised for delivery of the £1 notes. A new invention has recently been put on the market for checking, counting and registering £1 and 10/- notes and also vouchers, coupons, etc., but this is useful only for taking in notes, which require to be inserted one at a time. It must be observed, however, that counting of coins absorbs about two-thirds of the total time taken in the making up of wages.

ng. Sorting is the act of bringing a number of units together into groups having the same or similar characteristics, and arranging them in a certain systematic sequence. Sorting differs from "selection" - the extracting of units of a certain kind from a group that has already been sorted in a different order. The design, lay-out and use of sorting equipment has long received systematic study in the Postal Service in view of the extent and importance of that function there. Obviously, the main objective is to secure maximum speed and efficiency coupled with the minimum expenditure of labour and money. In this, as in other cases, a /

a critical examination of every stage in the work may suggest the elimination or simplification of processes of identification for sorting, the expedition of movement between the sections, and finally the application of scientific machinery to the sorting itself. As will be appreciated, the essence of mechanical scope is uniformity. In the case of one dimensional variation, the single variable function can be directed to operate the machine (as in a pressure gauge). Where another factor is a "function" (mathematical sense) of the first (e.g. temperature and pressure) the two may be related without disconcertion. But where unrelated variables occur with irregularity, the difficulties of mechanisation are evident. The mysteries and marvels of modern engineering technique and the amazing degree of accuracy obtainable therefrom have as yet little application in the field of sorting, for the very reason of irresponsible unrelated variations.

The seeming simplicity of sorting documents readily suggests mechanisation, but the intractability of the material to be sorted in terms of a uniformity which mechanisation demands has had two different but equally important results, viz. -

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(a) Where the physical entity of the material to be sorted must be preserved, e.g. parcels, etc., complete mechanisation is impossible and attention must be concentrated on the factor /

factor in the process (e.g. conveyance) most easily mechanised, supplemented by understanding, sympathetic or adaptable human hands and brain.

rsion sorting.

(b) Where the material can be translated into sound, light or other mechanically interpretable form such as punched holes or some such other media, mechanication is not only possible but highly automatic, accurate and speedy. (See next Chapter).

As item (b) will be dealt with under the next chapter, attention will be directed mainly to (a) at this stage.

ing.

Sorting by machinery (without conversion) has got to rely on an economic combination of thinking and manipulation. The process of speedy thinking can be stimulated in a variety of ways. The proper arrangement of primary, secondary, etc., sorts enables the mind to concentrate on a single phase at one time, thereby ensuring greater precision and accuracy. The use of colours and symbols on documents, variation in shape or size, and the use of classification codes or numbers always appearing in the same location of the documents, are among the more obvious aids. A careful selection of individuals with quick reactions, good space perception, locomotor activity and memory, is also important, as fatigue is very apt to arise with some individuals owing to the continuous mental decisions to be taken and to the correlated activity necessitated by that decision. Manipulation is largely a matter of the combination of human skill and devices to maximise it. Peak traffic periods in sorting are very common, and furthermore /

furthermore any undue delay in this operation may hinder the flow of work in other departments. But those very peaks make it difficult to justify on economic grounds expensive machinery which is only required at very limited periods of the day.

The office devices for sorting are -

(a) Pigeon holes or racks suitably ranged
(b) Travelling sorters
(c) Needle sorting.

Pigeon-hole sorting may involve a primary, secondary and even tertiary sort, as there are limits to the convenient reach of an individual. To overcome this difficulty, cabinets, trays and travelling sorters have been developed whereby pigeonholing can be done from a keyboard through a system of codification, and travelling belts take the material direct to the pigeon hole which would otherwise be out of reach of the individual. In this way, the number of different groups that can be formed in one operation is considerably larger. This number also depends on the size of the documents and the number in each group. Such installations are, however, costly, noisy and occupy a very large space. They have been adopted in certain post offices where the volume of work justifies the expenditure.

As far as the normal office is concerned, there is really only one known non-mechanical device which is a direct improvement on the very restricted range of pigeonholes, viz. the Sortergraph - a system of filing or a preliminary /

preliminary to filing. It comprises a series of flaps (25 - 150 pockets) appropriately labelled for the sorting operation, making suitable compartments for inserting documents. Larger equipments (900 - 1,800 pockets) are mounted on rails and noiseless fibre tracks, so that the sorter can sit between two parallel columns and move the series of compartments backward and forward according to the requirements of the movement. In this way, through bringing destination to document -

(a) a far greater range for a primary sort can be undertaken at one operation - indeed the whole sort may be done at one operation;

(b) much fatigue is eliminated through stretching out being unnecessary and hand and eye travel being greatly reduced; and

(c) space required for sorting is greatly reduced.

The appropriate compartment is brought rapidly to the sorter, but the determination of the appropriate home for the document is still a mental process for the individual.

Needle sorting, based on the principle of sorting by repeated selection, can most appropriately be considered in the next chapter dealing with the punched card art.

usion. A consideration of machines would not be complete without some reference to the aspect of adaptability. It may be stated as a general principle that the most efficient office machines from the point of view of operating are those designed and manufactured for the carrying /

carrying out of a single operation. Examples of these are postal frankers, folding, cheque signing and letter opening machines. The reason for this is that, with only a single and simple function to perform, a very high degree of automaticity can be applied to the work. There are, however, disadvantages in having a machine lying idle for very considerable portions of the day, particularly where the capital cost thereof is considerable. In contrast, there is the attractiveness of a multipurpose machine, particularly for the smaller business, even at the sacrifice of some measure of efficiency in specific operations. Comprehensiveness, adaptability, and general utility, must be judged in contrast to automatic features, and high output in relation to the needs of a particular business, special attention being directed to the ease with which a machine can be changed from one job to another. In the smaller office, the whole time of one machine cannot generally be economically justified in one job. Flexibility in such cases assumes the greatest significance, even though a relatively dearer machine on this account may be necessary.

The design of a machine for a particular purpose does not rule it out of count for some other purpose. It may not give equal efficiency in all of a variety of jobs, but where the major purpose is being adequately served, it may /

may be practicable to modify some subsidiary jobs to suit the machine, but, as a general principle, the machine should suit the job rather than that the job should be adjusted to suit the machine. Office mechanisation in relation to the size of a business will, however, call for consideration later, but it may be stated that the two most definite trends in office machinery are the tendency, on the one hand, towards the development and application of more complicated machines capable of performing several functions at one operation, and, on the other, towards an extreme simplification and specialisation on a function or a fraction thereof at an ever increasing speed. The warring of these opposing tendencies is all to the good, and is a perpetual challenge to the administrator faced with the problem of selection. The canons of economic science can at best afford but general guidance in emphasising that, on balance of advantage, the lesser must give way to the greater, and that one particular aspect of office mechanisation cannot be rightly adjudged without reference to the system as a whole. There is no ready made substitute for an intimate knowledge of the work, and of the machine, and both of these involve concentration and study. The guiding principles here given will, it is hoped, afford some assistance in a field which has, so far, been but scantily surveyed.

CHAPTER XV.

The Punched Card "Art".

"And you, my critics! In the chequered shade
Admire new light thro' holes yourselves have made."
(Pope, Dunciad, Book IV, p.125).

uctory. The punched card art is essentially a new language - an artificial language - designed for the purpose of mechanical interpretation before being retranslated back into its mother tongue. It is a peculiar language. Like other languages, it is a vehicle for the conveyance of ideas and facts, but it achieves its object by relying not on sound but on position, as its alphabet comprises only one letter - the punched hole. Where "position" occupies such a unique status, the key to the language is the particular plan of interpretation. Once this has been grasped the punched card art becomes intelligible.

Knowledge of permutations and combinations enable us to understand the construction and flexibility of a language comprising twenty-six letters which can be found in a variety of combinations. Hardly any plan is necessary for their use, and one dictionary, with periodic revision, can serve for all time and circumstances. Where, however, the alphabet comprises a punched hole which is as like to its /

its neighbour as the proverbial pea, reliance for differentiation of meaning must be put on some other factor. The uniformity of the punched hole is suitable for mechanisation and the diversity factor to enable it to mean different things is supplied by having a ~~diversity~~ range of position plans for the various uses to which it is desired the principle should be applied. Perforation for subsequent mechanical interpretation has been used with much success in the manufacturing world for a very long time. In lace manufacture and in linen weaving, for example, designs have for long been translated into a predetermined code of perforations on cards of a certain standardised size, linked together to secure continuity. The needles go in and out of the holes and only when there are holes.

The idea of using perforations for statistical purposes was first conceived by an Englishman named Babbage who may be said to be the originator of the calculating machine. It was not, however, till 1870 that Professor Hollerith developed the perforated card system for the purpose of compiling the results of a census. In 1911 the British Government adopted this method for such statistical purpose.

Punched card machines for office use stand in a category by themselves, and represent the highest development in office mechanisation. On this account, it has been /

been thought convenient to review this method of office mechanisation in some detail, as its application emphasises in an accentuated form all the main principles already enunciated. Originally designed for census purposes involving many classifications and statistics in immense quantities, the machines have proved invaluable for accurately and rapidly handling this work. In this field they have no real competitors. In the more modern development of accounting records, progress has been slower, owing to the competition of other effective machinery involving less of a revolution in office method and outlook, and much less of an initial outlay.

In Appendix No. 28 a list has been given of the uses to which the punched card is now being applied with the object of indicating the immense possibilities of this machinery.

Appendix No. 29 gives an example of coding to translate the (numerical) punched hole into an alphabetical translation.

Appendix No. 30 gives alternative methods of summary multiplication by approaching the problem from opposite factors.

Before approaching the wholly mechanical system of sorting and tabulating by the punched card, it may be appropriate to consider the non-mechanical applications in use with card systems.

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The Paramount system of card sorting involves the use of standard cards on a unitary principle (one card for each unit - a birth, death, etc.), with a line of circular holes, exactly registered in uniform positions along each of the edges. According to the nature of the information contained on these cards, certain holes are converted into slots. If the cards are stacked in the same way, with the edge containing the range of holes among which selection is to be made uppermost, a "knitting needle" run through the series at any of the positioned holes will lift those where the hole has been left intact and fail to lift those where the hole has been converted into a slot. In this way it is easy to select from a batch of cards, arranged according to some other factor, those cards answering to a particular classification.

By repeated selection, the sub-divisions of a classification can be as readily selected, provided plans have been made to this end in the design of the card. Different interpretations can be given to the same hole position according to the purpose of the card, provided these cards are filed and handled separately. The system may be combined with other methods such as colour, shape, size, such differences being so readily apparent as to preclude inclusion in a single interpretation. This semi-automatic method can be applied with equal facility to numerical, alphabetical /

alphabetical or factual sorting. The essential feature of such a system is that the card itself is intelligible from its manuscript details apart altogether from an intimacy with the sorting arrangements. Thus there need be no divorce between the card of original entry and the sorting medium, a feature which has much to commend it.

A further reference may be made to a card finding system which greatly facilitates problems in connection with using a card index. A standard card (of which there are several convenient sizes) is utilised with punched holes in the body of the card according to a predetermined plan of classification. As explained in the Paramount (perimeter) principle, classification is determined by slotting out the punched hole to the edge, and selection is made by inserting a rod through the whole of the cards at the appropriate hole and lifting up the rod. Those cards which have been slotted will remain, provided the selection position being operated is on the top of the card. If the selection position is on any other edge, that edge of the whole of the cards can readily be brought into that position. In the case of the body hole principle, the classification is determined by punching out so as to join two or more vertical holes together, and selection is completed by cards being placed in selector drawers, the front of which are perforated to correspond with the cards. Rods are inserted in the position /

position corresponding to classification desired, the drawer inverted, and those cards having the slots fall down half an inch. A locking rod is then inserted, and the drawer set upright with the selected cards held above the others. Upon removal of the locking rod, cards revert to their original position ready for further selections. The use of this method of selection in no way interferes with its use as an ordinary card index, and arrangement according to the filing order is in no way disturbed.

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The punched hole as a medium for operating an office machine on the same principle as that employed on player pianos has been applied with success to the typewriter for the mass production of individually typewritten letters. Stops may be cut in the record to permit of the manual insertion of a paragraph specifically applying to the recipient. A dialling device in the selector enables letters to be composed from the selection of a number of paragraphs cut in the record, the machine automatically skipping those not required. An operator can attend to up to four automatic typewriters.

In much the same way a punched roll can be applied to the selector arrangement of the Adrema addressing machinery to determine the selection of certain plates in the system. If, for example, a roll is punched for each account /

account paid, the roll applied to this machine will print second notices only to those customers whose accounts remain unpaid.

These, then, are but isolated examples of punched holes being made to serve particular purposes, and, as such, are mere adjuncts to an existing system. These applications do not affect organisation as a whole. The adoption of a complete punched card system does, however, go to the roots of organisation itself.

main inciple the nched rd art.

The primary requirement of a punched card system is that of planning a series of cards, each plan being a unit for a phase of the mechanical interpretation and production of office records, translating documents of original entry to these planned cards by way of positioned holes, feeding these cards after verification in bulk into an electric sorting and tabulating machine which has already been set to answer certain questions, and thereafter reading off the printed answers.

le Equipment necessary,

a) The card and unit.

A card of a certain size and quality is the basis or raw material on which the system works.

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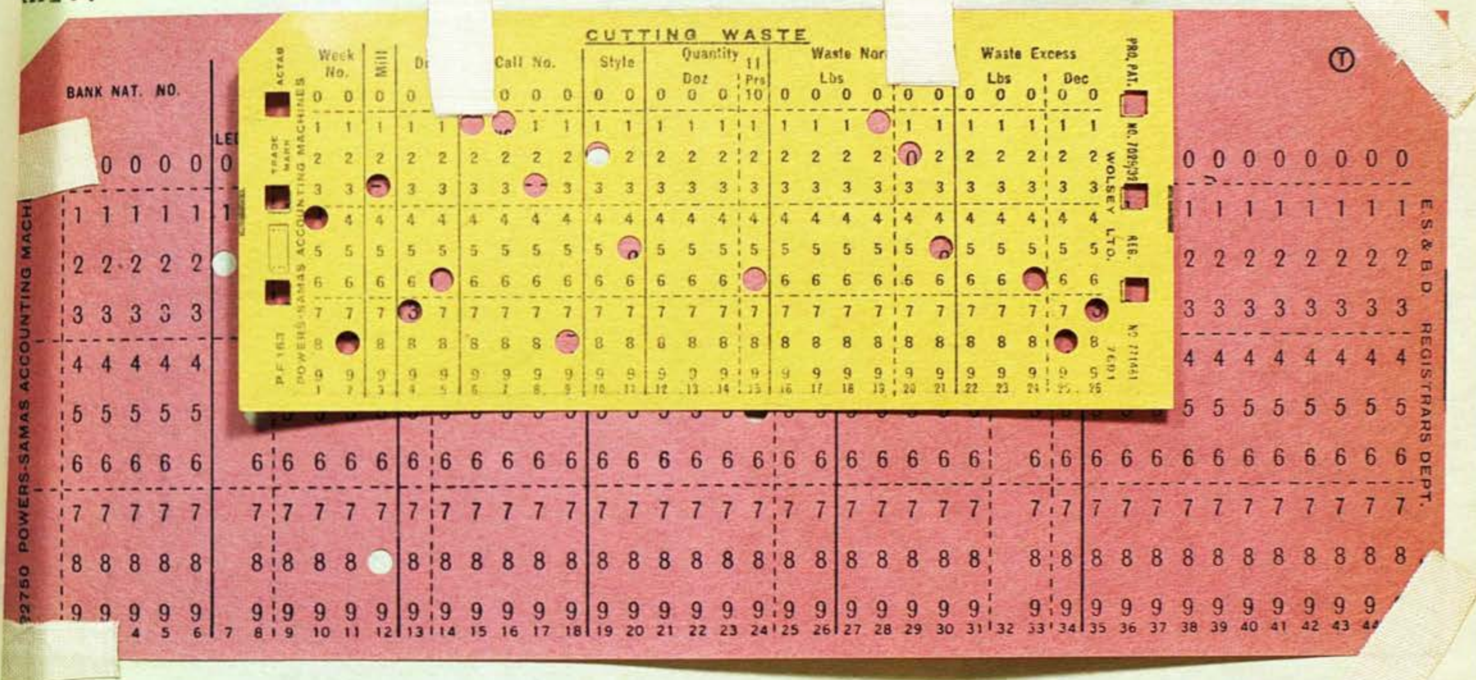

The card, the size of which may vary according to certain limits ~~It~~ comprises a series of vertical columns with definite positions for figures from 0 to 9 with two additional positions if required, each column of which is also in a definite position. Thus there are a settled number of vertical columns with ten positions in each, and these positions may represent anything. The plans determine what each position shall mean for any particular purpose. For an indefinite number of additional purposes fresh plans are necessary. Each plan has an individuality of its own, dissociated from all other plans, and, as such, must be treated individually.

Within the limit of the capacity of the card, provision /

provision is made for the representation on it by way of punched hole, of any information which is capable (for the time being and by convention) of being numerically represented. The grouping of information belonging to one fact of the situation, and as represented between the heavy lines, is known as the "field", the field being merely a part of the whole lay-out of the card.

The extent of any particular "field" is a matter of the purpose and design, and may vary from plan to plan, the family of plans representing the extent of the application of the machinery to the office work. Like the natural family, this is capable of increase according to the economics of the situation.

Broadly, two forms of cards are in common use, viz. the single and the dual purpose card. The single purpose card is a card prepared from original documents solely for machine manipulation and interpretation, while the dual purpose card may itself be a document of original entry capable of normal visual interpretation, but at the same time punched - or capable of being punched - in the appropriate fields for machine manipulation and interpretation. The card-punching machine is so constructed as to enable a card to be perforated in the twelve fixed and numbered positions in each of the vertical columns, so that each /

each hole can be identified by reference, firstly, to the column in which it occurs and, secondly, to the numbered position which it occupies in that column. The function of the sorting and tabulating machines is to pick out, count and record the cards which have a particular hole or holes punched in them. Thus, from the assigned meanings for each punched hole, the items are enumerated and recorded by the machine for the purpose in view.

) The Punch.

The process of punching is merely that of translating information from original documents into the form capable of mechanical handling by way of a standard card. This operation is performed on a key punch which is similar in operation to a typewriter, but, owing to the small number of keys - 0 to 9 - its speed is considerably higher, much less skill is required in its operation, and the touch method can rapidly be acquired. Cards can be punched at a rate varying from 500 to 700 per hour, depending on the amount of punching on each card, and on the ready interpretability of the original document.

A blank (unpunched) card is inserted flat in the punch and pushed to the right hand side. In the course of operation it travels towards the left. In the more modern forms of punch, the cards are fed automatically into the machine from a stack and automatically ejected and stacked as completed. As facts are required to be punched on /

on the respective fields, the appropriate keys 0 to 9 are depressed, and the machine punches a hole in the correct position, at the same time spacing the card to the next column. Provision is also made for back spacing, repeat punching and automatic counting of cards punched. Columns or whole fields may be skipped as desired, by the simple operation of depressing the space bar, and further punchings at some future date can be done when it is desired to insert some further information. A different type of punch enables a whole card to be "set up", all columns being punched simultaneously at the end of setting up. This has the advantage of enabling corrections in setting up to be made as soon as discovered, and before any actual punching is done. As in the case of the typewriter it is often recognised that an error has been made as soon as a wrong key has been depressed. It is claimed that a very low error rate is obtained from this type of punch.

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ntry.

In order to secure a good output of punched cards per hour, it is desirable that the order of information on the document of original entry should, as far as possible be the same as that of the fields on the card to be punched. This not only greatly facilitates the punching, but it may also facilitate the speed and accuracy in the preparation of the original document by minimising clerical work. An example is given below, taken from the Telephone Sales Bulletin /

Bulletin, April-May 1936 and quoted in the Powers-Samas Magazine, July 1936 by permission of the Controller, H. M. Stationery Office.

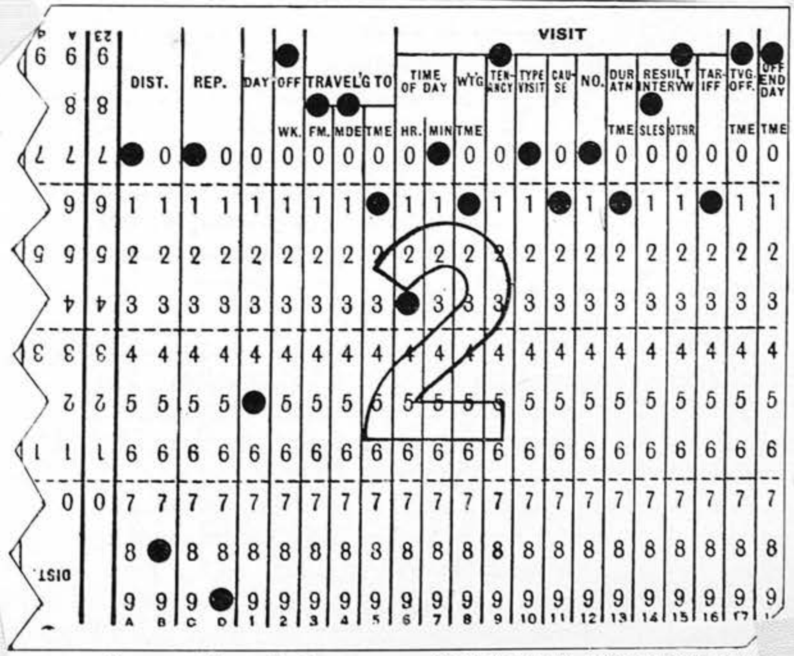
ANALYSIS OF SALES WORK—MARCH, 1936. P.R.D. (S.I.) 1/1936

District No. 8 Sales Representative No. 9 Initials CHF

CODE No.	Day (1)	Office Work at Headquarters Time Mins. (2)	Travelling to Visit From (3)	Chief Mode (4)	Time Mins. (5)	CODE No.	Particulars of Visit: Time of Day Hour (6)	Mins. (7)	Waiting for Interview Time Mins. (8)	Type of Tenancy (9)	Type of Visit or Call (10)	Initiative Cause of Visit (11)	Number of Visits in past 12 Months (12)	CODE No.	Particulars of Visit (Contd.): Duration of Interview or Call Mins. (13)	Result of Visit: Primarily a Sales Call (14)	Other Call (15)	Tariff under which Order Taken or Other Business Transacted (16)	Travelling back to Office Time Mins. (17)	In Office at end of Day Time Mins. (18)	CODE No.
12	Mon. 2nd	None	Not Applicable	Not Applicable	None	12	A.M. 8	0/14	None	BUSINESS Farm	Subr. by Appntmt.	Not Applicable	Not Applicable	12	None	Not Applicable	Not Applicable	Not Applicable	None	None	12
11	Tue. 3rd	Up to 5	Previous Visit	Foot	Up to 5	11	9	15/29	Up to 5	Indstl. Engrg. & Manfrg.	Subscriber without Appntmt.	No Lead or Introduction	1st	11	Up to 5	One Exchange Line	Cessation Withdrawn	Business	Up to 5	Up to 5	11
0	Wed. 4th	6/10	Office 1st Time	Bus or Tram	6/10	0	10	30/44	6/10	Shop or Retailer	Non-Subr. by Appntmt.	By Introduction	2nd	0	6/10	One Extension	Cessation Not Withdrawn	Business, Small User	6/10	6/10	0
1	Thu. 5th	11/20	Office 2nd Time	Train	11/20	1	11	45/59	11/20	Professional	Non-Subr. without Appntmt.	Follow up of C.M.58	3rd	1	11/20	Other Order for Exch. Lines or Stns.	Removal or Transfer Arranged	Residential	11/20	11/20	1
2	Fri. 6th	21/30	Office 3rd Time	Cycle	21/30	2	Noon 12		21/30	Other Business	Prospect Enquiries	Follow up of Letter or Literature	4th	2	21/30	Misc. Apparatus	Further Visit Proposed	Other Exch. Service	21/30	21/30	2
3	Sat. 7th	31/45	Office after 3rd Time	Motor Cycle	31/45	3	P.M. 1		31/45	RSDNTL. Under £350	Telephon'g Orders	Enquiry Card	5th	3	31/45	Agreement Left or to be Sent	No further Visit Proposed	Private Wire Services	31/45	31/45	3
4	Mon. 9th	46/60		Private Car	46/60	4	2		46/60	£350 to £500	Telephon'g Office for Instns.	Letter or Enquiry from Client	6th	4	46/60	C.M.58 for further Visit	Responsible Person Not Seen	Misc. Services	46/60	46/60	4
5	Tue. 10th	Over 60		Official Car	Over 60	5	3		Over 60	Over £500	Telephon'g for Appntmt's	Goodwill	7th	5	Over 60	C.M.58a for further Visit		Not Known	Over 60	Over 60	5
6	Wed. 11th			Other Means		6	4			Unclassified	Other Misc. Office Work	Notice to Cease	8th	6		No further Visit Proposed					6
7	Thu. 12th					7	5			MISC. P.O., Ex., or Engrs.		Removal	9th	7		Responsible Person Not Seen					7
8	Fri. 13th					8	6			Call Office		Transfer	10th	8							8
9	Sat. 14th					9	7			Other Visits		Service Complaint, Enquiry, or A/C Case	11th or Over	9							9

(90901) Wt. 32620/P412 5000 pds. 1/36 Hw. T.2315

A SPECIMEN ANALYSIS FORM



—AND ITS PUNCHED CARD COUNTERPART

Another example may be given - "Medical Inspection of School Children - Routine Examination". -

MEDICAL INSPECTION OF SCHOOL CHILDREN — ROUTINE EXAMINATION

SCHOOL No.	SCHOOL	P.D. or M.D. School or Class	Admission No...... ....

TYPE	DATE OF INSPECTION	CLOTHING	CONDITION OF SKIN	TEETH	LYMPHATIC GLANDS	VISUAL ACUITY	HEART AND CIRCULATION	TUB.(NON-PUL.)	DEFORMITIES	CLASSIFICATION OF DEFECT	X
1. Ord. N T. 2. Ord. Trans. 3. Phys. Defect 4. Ment. .. 5. Nursery	D. M. Y. .... 1. Parent Present	R. Insufficient X. In need of repair O. Dirty	HEAD R. Ringworm X. Impetigo O. Favus 1. OtherDisease	R. Sound § X. 1-4 Decayed O. 5 or more do .... 1. Oral Sepsis	SUBMAXILLARY R. PalpablyEnl X. Markedly do. O Suppurating O Cicatrices §	R. Good § X. Fair O. Bad	R. Org. Cong. † X. Org. Acq'd. * O Functional Disease 1. Anæmia	R. Glandular X. Bones. Joints O. Abdominal 1. Skin 2. Other Forms	R. Congenital † X. Acquired * O. Infect. Dis. 1 Rheumatism 2. Other Disease or Defects	REMEDIABLE: 1. None 2. Clothing or Clean. only 3. Other def. 4. Cloth'g or Clean and other IRREMED.: 1. None 2. Acq. only 3. Cong. .. 4. Ment .. 5. A. + C. 6. A. + M. 7. C. + M. 8. A + C + M	0 ... 1
HOUSING Ads............ Chd .... Total .... Apts............	AGE Yrs .... Mths	FOOTGEAR 1. Unsatisfactory 2. None	BODY 2. Ringworm 3. Impetigo 4. Scabies 5. OtherDisease	NOSE 2. Catarrh 3. Obstruction 4. OtherDisease	CERVICAL 1. PalpablyEnl 2 Markedly do. 3. Suppurating 4. Cicatrices §	EARS 1. Otorrhoea * 2. Wax 3. Other Dis. HEARING 4. Slightly Deaf 5. Markedly Deaf*	LUNGS 2. Chron. Bron. 3. Tuberculosis 4. Susp. Tub. 5. Other Dis.	RICKETS 3. SLIGHT	VACCINATION 3. Unvaccinated 4. Vaccinated 5. Re-vaccinated	STANDARD CLASSIFICATION Remediable (unmarked) Irremed.—Acq. * .. —Cong. † .. —Ment. ‡ No Defect §	2 3 ... 4
1. To be re-examined PARENT NOTIF'D 1. Card 2. Verbal 1. Excluded	SEX 0. Male 1 Female HEIGHT (ins.) .... WEIGHT (lbs.)	CLEANLINESS HEAD 3. Dirty 4. Nits 5. Verminous .... BODY 6. Dirty 7. Verminous	NUTRITION 6. Good § 7. Fair 8. Bad 9. Very bad	TONSILS 5. Slightly Enl 6 Markedly do. ADENOIDS 7. Probably Pres 8. Present .... 9. Other Throat Diseases	EXT. EYE DISEASE 5. Blepharitis 6. Conjunctivitis 7. Corneal Op. * 8. Strabismus 9 Other Dis.	SPEECH 6. Defect Art. 7. Stammering MENTAL CONDITION 8. Dull or Bkwd 9. Ment. Def. ‡	NERVOUS SYSTEM 6. Epilepsy ‡ 7. Chorea 8. Inf. Par. * 9. Other dis. †	MARKED 4. Individual * 5. Knock Knees 6. Bow Legs 7. Curved Tibiæ 8. Pigeon Breast	6. Child Employed	If Standard departed from, give details on back and mark X below............	5 6 ... 7
		COL. 38	COL. 39	COL. 40	COL. 41	COL. 42	COL. 43	COL. 44	COL. 45	S.M.O. No................	8

D. Initials...................... | Classificat'n: Rem Irr. S.C. | S.M.O. | School No. | Type | Housing: Inm Apts | Re-Ex. | P.N. | Excluded | Date: Day Mth Yr. | P.P. | Age: Yrs. Mth | Sex | Height | Weight | Field headings as shewn on Card | 9

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44

"HOLLERITH" 20531 The British Tabulating Machine Co., Ltd., Victoria House, Vernon Place, W C.1 Printed at Letchworth, Herts.

"It will be noticed that every condition which may be found "by the examining doctor is plainly printed on the face of "the card alongside its appropriate code number. All that "the doctor is required to do is to score through with his "pen the line which applies and this marking indicates to the "operator what figure or figures to punch in each successive "column. The card is so designed that the coded information "is visible to the puncher when it is required.

"Another point of interest is that more than one head "of information can be recorded in one column of the card. "Reference again to the 'School Children' card will disclose "that column 38 includes Clothing, Footgear and Cleanliness, "whilst /

"Whilst columns 39 to 45 are all of them multiple records.

"This type of recording, similar to that used for "Census work, is not, of course, suitable where figures "have to be added, but only where the ultimate function is "one of counting. For example (in the card under review) "the punching of a '4' in column 42 indicates that the "individual child under examination is slightly deaf. "This figure '4' has no arithmetical significance and will "never be added as '4' but will be counted as 1 (category 4) "in arriving at the number of children so affected."

"For this purpose a special Card-counting Sorter is "supplied which is capable of:-

i. Sorting in the normal way.
ii. Counting without sorting.
iii. Sorting and counting simultaneously.

"In the latter connection it is possible to sort on one "column of the card whilst simultaneously counting on "another. Further than this, the operation of this "machine is not limited to counting one hole in each "column, but any or all positions may be punched, as "exemplified in the 'Medical Inspection of School Children' "card already referred to.

"The speed of the machine is 400 card passages per "minute, and extra counters are provided giving sub and "grand totals and for counting unpunched cards. A selecting "device enables all cards punched with any individual hole "in a single column to be sorted out while the remaining "cards /

"cards are passed into the 'reject' pocket without "disturbing their sequence."

fication punched ds.

In order to ensure a very high degree of accuracy in the final results, it is customary to have all punched cards verified in every detail. For this purpose there is provided a verifying punch which, if operated on the same lines as the punch itself, will detect, by the locking of the machine, any errors of omission or commission, subject to this, that if the second operator should, by chance, make the same error as the originator of the card, such a double error will not be detected. In the best type of verifying punch, not only does the verification of the correctly made holes take place, but attention is automatically drawn to any other holes in the column being checked. Skipping mechanism can be fitted to pass over automatically any unused columns where no verification is involved, and for control purposes the cards passing through this process can be automatically marked by an inked stamp on the card. The checking plate method can also be employed to automatically check all "fixed" information, conscious checking being limited to variable information only.

Within recent years, great strides have been made in further mechanising this essentially routine job of punching and verifying cards. For example, by the aid of the electric duplicating punch, perforations in any "master" card /

card inserted on the upper portion of the machine may automatically be repeated on a blank card fed into the lower portion. In this way, information common to one or more cards can be automatically reproduced singly or in bulk. Punching of cards in bulk prior to their actually being required and their subsequent circulation as a transaction is a common place in stock recording. The extensive use of prepunched cards is limited by certain well defined considerations. The ideal situation for this practice is one where the number of variations is relatively small. In such cases the pulling of prepunched cards is the quickest and most accurate method of accomplishing the punching operation. Again, development is taking place to associate the simultaneous production of a punched card as a by-product of the preparation of the original document, e.g. receipts by Cash Register. If invoicing is done on a typewriter connected to a punching device, it may be possible in the near future to have all the essential facts of the invoice reproduced in punched form for subsequent ledger posting, stock records, etc.

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orting.

The process of sorting is that of grouping together the cards, irrespective of their original order, having those characteristics (as evidenced by certain punched holes) regarding which it is desired (as expressed by the setting /

setting of the selectors) to tabulate and produce totals. The design of the card will have taken into account the "fields" necessary for the purpose in view, but the order of "fields" tackled in the sorting is a matter of the requirements of the moment. Cards can again be sorted and resorted back to any order by a new machine called a collator. This machine provides an automatic, fast and economical means for filing current cards with previous cards, combining "master" or name and address cards with detail cards, and eliminating others. A special selective sorting machine is now available which will pick out desired cards, substituting therefor coloured signal cards, and later resorting the series back into the original order. This entails no more trouble than replacing the cards on the sorter, resetting the sorting keyboard, starting the machine and collecting the cards in their new order, as the machine works electrically at a speed of 24,000 cards per hour. One type of sorting machine operates through the card acting as an insulator between a brush and a roller, while another operates through a series of sensing pin boxes which become operative and connect with wires in the connection box when holes appear in cards. Where a hole occurs in the field for which the sorter is set, contact is made which opens a chute corresponding to the position of the hole and permits the card to pass into its appropriate compartment. There is also a compartment for rejects such as /

as unpunched cards. The sorting proceeds a column at a time (which may be only part of a field), but second, third, etc., sorts are done in the same way by resetting to the next column until the field has been exhausted. Thus, sorting is done into thousands, hundreds, tens and units until the desired order has been attained. This sorting can be completed by anyone possessing practically no mechanical skill or clerical experience, at a rate far surpassing any other known method. The machine stops of its own accord when a sorting compartment is full or when the supply of cards is exhausted.

ulating. The final stage in the mechanical manipulation of the punched cards is tabulation which involves totalling the cards or the quantities or values or groups of figures punched thereon so that a statement may be produced to answer the questions of which the cards are capable according to the information they contain. Tabulation may be accomplished by merely reading the various meters on the machine (non-printing tabulating) or the results may be automatically printed on the prescribed form by the machine itself (printing tabulator). The operation of the tabulating machine in its mechanical aspect is similar to that of the sorter, in that the presence of holes in the various positions enable contact to be made and so actuate the appropriate mechanisation of the machine, with two differences.

Whereas /

Whereas the sorter, concerned as it was with sorting, brought the appropriate compartment into active service and conveyed the card to it, the tabulator brings into action counters or adding wheels and (in the case of printers) type bars corresponding to the value of the hole. Again, whereas the sorter senses one column at a time for the ultimate purpose of determining a strict individual order, the tabulating machine, the concern of which may be detailed recording as well as aggregating, senses the whole of the columns at one operation, extracting from them the whole of the information they contain, including words as well as figures, and will continue its work so long as there are cards to feed through the machine. So automatic is the machine that, should a wrong card or cards (i.e. with fields which did not correspond with those for which the tabulator is set) be included in a group, the machine will stop, print the irregularity as a separate entry and continue with its work at a maximum speed of 9,000 cards per hour, or, in the case of the printing tabulator, at about half this speed. Adding, subtracting and sub-totalling are equally automatic by arrangement. As was indicated, provision may be made in the card for any information which may be numerically represented. By a conventional arrangement, the twenty-six letters of the alphabet may be accommodated /

accommodated according to a predetermined punching position, and an electrically operated automatic punch has been perfected for use with an alphabetical printing tabulator. This machine has a standard typewriter keyboard. On the depression of a key, either alphabetical or numerical, the appropriate holes are punched on the card. At the same time, the letter or figure is typed along the top of the card for filing or reference. Cards are automatically fed into the punching position and automatically ejected after punching. This invention has greatly widened the scope and application of the punched card.

In the process of tabulation there are numerous adjustments that can be made simply by a series of switches and settings on the selection plugboard.

Certain punch holes (such as reference numbers) can be made non-add, others can be made to repeat on more than one counter at the same time. The cards can be counted as they pass through the machine.

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efinements.

The punching of summary cards from completed tabulations in order to reduce the number of cards to be dealt with in subsequent operations can also be done automatically. For work involving the rapid feeding of separate invoices, ledger sheets, etc., into the tabulating machine, a sheet feed device is available which automatically feeds, positions and ejects the particular form without in any way /

way interrupting or retarding the speed of the tabulator. This automatic and accurate positioning and line spacing of each ledger sheet to be posted is achieved through the snipping of one edge of the sheet for each line posted. This relieves the operator of any care or thought in this connection, and greatly speeds up output. Another feature for preindicating the next account to be posted ensures accuracy, while the automatic printing of balance cards for use on the next occasion of posting effects a very real economy of time and effort. The introduction of an automatic reproducer punch for producing any number of punched or partly punched cards from a master card has effected a considerable saving in the preparation of punched cards, not only by reason of the labour eliminated, but also by reason of the elimination of the need for verification of such punching. A further advance by the introduction of a reproducer for duplicating one set or section of punchings into another set of cards, has made for progressive efficiency. By applying this reproducer the quasi-permanent portions of information in one set of cards can be automatically transferred to the new cards in the same or in a different position, or a closing balance on one set of cards can thus be transferred as the opening balance on another, again with savings of labour and verification. Further, the reproduction of former information /

information with the addition of gang punching of new particulars can be done at one operation, involving the minimum of conscious effort, at a speed of 100 cards a minute.

A recent feature in the interchangeability of feed enabling long or short cards to be dealt with on one plant is a factor which tends to economy by limiting the size of card to the needs of the special purpose. A new "Card Economiser" is a logical step from this idea of interchangeability, and enables a full-sized card to be punched in three or four panels and then slit in a cutting machine into either three or four small cards. One not inconsiderable advantage of this method is the saving of time in feeding and ejecting cards from the punch and punching is really the only manual operation in the procedure.

The introduction of the multiplying punch which gives two punched factors, the multiplier and the multiplicand, and at the same time produces and punches the product in any given position on the card, has also widened the economic application of the punched card art to such operations as wages, pricing of materials, inventories, etc., as speeds from 700 up to 1,200 calculations and punchings per hour have been obtained in this work. A unique feature is the ability of this punch to perform direct /

direct multiplications in sterling and to punch a sterling answer, without any decimalisation. An adjusting mechanism will given the result to the nearest penny or halfpenny or one decimal point. It may, however, be pointed out that the extension of each item may on occasion be obviated by summary multiplication. (See Appendix 30).

he scope of the punched card.

It would be difficult to indicate the scope of the punched card in the economic undertaking of routine clerical work.

Appendix No. 28 gives a list of some of the uses of this type of machinery.

Broadly, it may, however, be stated that the production of accountancy and statistical records dissected according to almost any desired factor capable of exact or "gradable" order, is now the appropriate function of such sorting and tabulating machines. The influence they are capable of exercising on effective financial control or audit through the exact and speedy production of essential facts with the minimum expenditure of highly skilled and expensive labour, no matter how extensive the ramifications or how intensive the detailed needs of the undertaking may be, marks the punched card machinery as the acme of office mechanisation.

In all considerations as to the suitability of the punched card, it is of the utmost importance from the economic /

economic point of view to consider how much "fixed" information can be made use of day by day, or year by year. The greater the ratio of this, the better are the prima facie grounds for examining very closely the possibilities of the punched card. The annual preparation of a Valuation Roll may be cited as an example. Here the same name, the same ward, address, description, valuation, etc., may be repeated year in and year out in the vast majority of cases. Where a high percentage of particulars can be used over and over again as on the Survey Book, Valuation Roll, Assessment Ledger and Demand Note, and where such amendments as are necessary from time to time can readily be introduced by substitution of a new card, the economies resulting from the introduction of such a system may cumulatively amount to a vast sum, particularly when gang punching (whole streets at a time) can be liberally applied and when statutory sectional totals can be automatically secured through the use of master cards.

Repeated use of punched card.

An essential feature of the punched card is that it is the embodiment of information on tap, and as such can be utilised as and when required. In many spheres of office activity, standard information is required again and again for the same purpose or from time to time for a different purpose. The punched card is an appropriate medium /

medium for such routine purposes. Let us take the example of wage deductions. While gross and net earnings may vary from week to week, that part of the transaction represented by deductions may vary only exceptionally. By utilising a card for standard deductions, only the variable factor of gross earnings need be punched week by week, the cards for net earnings being automatically produced in the course of tabulation for wage bill purposes. The standard deduction card can also be used the requisite number of times for summarising superannuation deductions half-yearly, while the aggregate of gross and net earnings will furnish the income tax records at the same periods. In the same way, while local rates may vary from year to year, rateable value, classification, etc., of a property may remain constant over very long periods, and a card prepared for such stable information can be used over and over again in the preparation of a valuation roll.

'epunched ard ystems.

To refer to but one of the many problems which confront trading concerns, that of the economic control of stocks, the use of punched cards is of inestimable value. Unless a sound stock control exists, an excessive proportion of capital may be locked up in slow moving lines. Occasional marking down in value is an inevitable consequence of selling, particularly retail selling, but marking down should be done in close correlation with changes /

changes in demand. By a daily, weekly or monthly record of the trend of sales, operated with the minimum of trouble through a prepunched card system, many items of stock can be kept moving through slight reductions before they become "cold".

The prepunched card system may be economically applied by making use of the following principles:-

(a) Gang punching of a supply of unit cards for each article in stock.

(b) Performing the operation (a) when the load of other card punching is light.

(c) Summary punching in appropriate groups, e.g. the issue of 361 articles of the same class may be represented by -

1 card	for	300	(Green)
1 "	"	60	(Blue)
1 "	"	1	(White)
		361	

(d) A good storage system for prepunched cards.

(e) Control of maximum and minimum stocks may be facilitated by the introduction of warning colours.

By the use of the punched card for sales, the relation of buying and selling price to marginal utility can become a practical and almost continuous business rule in order to maximise net revenue. In large distributive trades, the huge volume and diversity of merchandise constantly circulating requires an exceedingly flexible method of recording and a prompt system for bringing the cardinal facts to the notice of the executive.

Double /

Double entry book-keeping has for long been associated with business enterprise, and when it is realised that the essence of this system is that every debit has a credit, it will be seen that the simultaneous punching of a debit and credit card for book-keeping purposes effects an enormous saving. Indeed, by discreet use of card plans, the one card can effect the posting of a debit and credit when the debit arises, and the other (simultaneously prepared) card can be utilised for the credit and debit when the debt is discharged. Subsequent pairing in this case can be used to bring out unpaid accounts. As regards this "marrying" principle, however, greater developments are undoubtedly possible. There is, however, another double aspect in almost every transaction. For example, from the point of view of the purchaser a chain becomes necessary of purchases made from a particular firm as a basis for invoice, account, ledger entry and ultimate payment. From the point of view of the seller another chain becomes necessary of sales made to a particular individual, again as a basis for invoice, account, ledger entry and ultimate payment. But from the point of view of the stock, individual items in these chains have to link up and be collated with every other similar item purchased by or sold to an entirely unconnected person to form another chain of receipts into or issues from stock.

Where /

Where there are different chains to be coped with which tie up in quite different ways, there is no known mechanical method which can cope with the situation like the punched card, because, while the punched holes are linked together in one card, they are, as it were, detachable at will to become at any time associated with other kindred links in other chains. There are many other chains to be considered and the limits to the use of the punched card are only determined by the fields for which the punching is provided. Particularly where this method of sales analysis and stock control can be effected without any additional work as is the case with the National Cash Register punch already referred to, the advantages are the more apparent.

There is this further advantage in the punched card system that numerous unit cards can be so quickly summarised, as contrasted with posting, that it will usually pay to summarise and punch a summary card for ledger posting, if direct reference to the individual transactions is not required as a general rule. Summary punched cards are automatically produced by the tabulator during the tabulation of detail cards. By summarising, it will be realised that in many cases one printing tabulator will cope with the work which, under other circumstances, might require two or more, and that, accordingly, still further centralisation of accounting work may be undertaken without creating "bottle /

"bottle necks" or peak loads. When it is realised that only certain facts taken from the detailed card need be summarised (there would be no result from summarising a list of reference numbers), it will be appreciated that the summary card will have space available on it for the incorporation of other facts, e.g. previous stocks and new balance, not obtained from the detail cards.

versality punched rd.

Just as a piece of music written by Beethoven is perfectly intelligible to a Scotsman who knows no German provided he understands the basis of musical notation, so a punched card has a universal intelligibility to those who are working on an agreed field plan. The punched card knows no frontiers. Its language is the Esperanto of the accounting world - easy to learn, flexible to meet varying needs and conditions, incapable of slovenly presentation, and lending itself to remote control inseparable from large-scale enterprise. Adam Smith it was who said that the stockholder was a citizen of the world. It seems desirable that such a citizen should have an accounting language capable of meeting his needs.

cial oblem.

The economic utilisation of the services of those afflicted with blindness is a social problem of no mean importance. While the suggestion is made without any investigation into the practicability of the matter, it would /

would appear that the punched card method of office recording offers great possibilities for the employment of such sufferers. It may well be that the sensibility of such workers and their capacity for memorising "fields" may yet prove a great asset in the development of the punched card, and we may look forward to this aspect of development being examined by those bodies entrusted with the obligation of finding profitable employment for the blind.

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ard.

Tabulation consists of two intrinsically different processes, namely, the determination of the exact nature of the recorded fact, and the counting and presentation of the items falling into the different classes or groups. The former process cannot always be mechanised, because it calls for judgment and decision. To take that decision, in some cases, requires very special knowledge. It is a problem of the mind. The latter process can be mechanised. Where the decision, once taken, is final and only counting and recording is involved, there is a <u>prima facie</u> case for the punched card. Where, however, the decision is only of a passing nature, subject to further observation as in the case of a doctor's preliminary diagnosis, the stage has not been reached for a punched card. Where the work leading up to the ultimate decision is greatly in excess of the work which follows it, the economies resulting from applying /

applying the punched card system will tend to be comparatively less. In such circumstances a more exacting examination of the merits of the case for punched cards should be made. This does not mean that an economic application cannot be made - far from it. The resulting economies from thus undertaking only the routine part of office work may more than justify its application, and the relief to expensive and skilled employees for work for which they have been educated and trained may save considerable expense in other directions.

The punched card system relies for its effective functioning on a carefully preserved punched card, and a delicate mechanisation for sensing those cards. Accordingly, documents which are liable to be folded, buckled or otherwise wrecked are not suitable for the purposes of the machine. There is thus a limited facility for the use of dual purpose cards.

e disadvantages of the punched card machine.

Notwithstanding the unrivalled merits of the punched card principle, there are disadvantages inseparable from the system. First of all, there is the considerable capital expenditure involved in the purchase of the equipment. One type of plant, it is true, is available for hire, but here again the annual charges are fairly high. Before such expenditure could be economically incurred, an adequate volume of work to keep the plant reasonably employed /

employed would be necessary, a rather difficult task in an ordinary sized business in view of the speed at which the machines operate. It is true that various sized installations can now be obtained which accord more with normal requirements, and the economies resulting from the effective operation may far outweigh the annual costs, but when the normal "unit" of the business is of low cost, the card, by the time it has been fully punched, may have cost much more than the article which it represents.[3] Accordingly, some consideration should be given to the value of the service represented by every application of the card.

In the second place, it must be realised that the punching of a card does not assist in any way in the preliminary stages of a transaction which is often the most arduous part, involving the maximum of organisation and expense, e.g. effecting a sale. In many cases, the work is practically done by the time the stage is reached at which a punched card can be prepared. The punched card, as representing a "<u>fait accompli</u>" is of very great importance from a recording and statistical point of view, but it cannot assist in interesting a prospect, investigating a complaint or carrying out the main purposes of a business.

Thirdly, the punched card, capable as it is of furnishing the most complete statistics, promptly and economically /

economically, can only be regarded as justified where such facts can be effectively <u>used</u> to improve the organisation, output, or methods of production, and effect economies in other directions, or where such facts must be got out by methods much more laborious and expensive. Where this does not arise, or where an irreducible minimum of staff must be employed for the main purposes of the business, it is doubtful whether, in the absence of special circumstances, this plant can be economically employed.

Fourthly, there must be some measure of class uniformity in the transactions of the undertaking to enable the process of determining fields to be fixed on, and these classes must be homogeneous. A woman's hat, for example, would not be an ideal unit. There are many cases in business where uniformity of classification is difficult.

Fifthly, there is the disadvantage that records kept by punched cards are not so readily intelligible as the written word. This objection has in some measure been met by the introduction of a numeralpha interpreter which meçhanically interprets the punching on the card and prints the interpretation on the card itself. The essential standardisation of position for each item on the card does, however, enable clerks after a little practice to memorise the position of the items in each panel and to make out cards fairly rapidly.

The degree of codification antecedent to the adoption of /

of the punched card system is sometimes regarded as a disadvantage. It is, however, very doubtful whether this is a very material objection. Codes can express in definite and easily recognised symbols the technical terms which not only confuse the clerical staff, but are always apt to lead to expensive mistakes. Coding simplifies clerical work, reduces errors and aids tabulation of results. Much in the same sense the unified office control essential to the effective operation of the punched card principle is sometimes regarded as a disadvantage, but if machinery is capable at the same time of service to many departments, there is every advantage in concentrating routine work where it can most effectively be dealt with. This is but one aspect of rationalisation, the transfer of the work to a point in production or distribution sequence where the difficulties can most easily be overcome.

Sixthly, the punched card system is based on the principle of storing up a mass of data until the end of a period or until such time as it may be required, and then promptly providing the record. If the storing aspect is unduly stressed, it may well be that the information may depreciate in value. This, however, is a matter for striking a happy medium between economic use of the machine and economic use of the data.

Seventhly, there is the problem of the filing and storage of the cards themselves. In the case of a large undertaking /

undertaking, the volume (and weight) of cards collected in the course of a year may be very considerable, and the individualistic nature of the card means that the office records become much more bulky than might otherwise be the case. This is a matter which requires very careful consideration.

Eighthly, where a considerable re-organisation in the design of the various cards repeatedly takes place, the historical continuity of the punched cards is destroyed, unless a proper record of such changes is kept. It is true that summary results will normally be tabulated in a readily intelligible form, but the long term analysis of punched cards may be desirable in respect of new circumstances. Careful filing of cards of changed design is, therefore, essential.

Lastly, there is the disadvantage of noise. It is doubtful whether this type of machinery will ever be silent in operation. Some measure of isolation may be involved.

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The place to be taken by the punched card in future office mechanisation is difficult to assess. The conditions precedent to its adoption, namely the enlarged size of the business unit, are already with us. The immense value of statistics in business is becoming more generally accepted, but the provision of up-to-date accurate /

accurate data still falls far short of the requirements of modern industry. Unfortunately, too many business executives are content to accept haphazard, belated information. The result is that when figures are known to be inaccurate or mere samples, the same drastic action is not taken as would happen with reliable data, and when figures are belated it is often too late to take effective action.

The use of statistics as the tools of business management and production control is to-day absolutely essential. With the accounting instruments available to the office there is no reason why every progressive concern should not be provided with vital statistics of every phase of its activities.

Accounts are not fulfilling their full measure of usefulness if they are merely a history of past transactions, for they can and should be instruments whereby business operations can be controlled and directed. Progressive business men have been quick to appreciate this wider conception of accounting made possible by the punched card art, and have realised that such accounting is a fruitful investment leading to increased efficiency.

It is sometimes contended that the facility with which statistics can now be obtained induces a tendency to produce them without adequate regard to their eventual usefulness. /

usefulness. In the early days of mechanisation, when punched card equipment was employed solely for the production of statistical records, this may have been so. Indeed, cases were known where valuable time and money were being expended in obtaining various analytical returns which were never put to any real use. But with the slump there came a drastic overhaul of the whole machinery of management, with the result that much wasteful expenditure of effort was eliminated.

Since the development of punched card machines into complete accounting machines capable at the same time of supplying all necessary statistics as part of the accounting procedure, concentration on the production of figures having very definite relation to the needs and progress of the business has been more marked. The machines themselves have an ever-enlarging capacity to cope with individual needs, and a technique is growing up which has, as its object, the economic application of the punched card to business needs. Pre-punching, gang punching, the punching of duplicates (or parts) from previous packs of cards, and automatic multiplication, subtraction and addition, summary multiplication, are examples from this technique. But perhaps the most significant feature of recent times is the production of the punched card as a by-product of the principal operation. Mention has been made of the card produced /

produced by the National Cash Register punch while giving receipts and the automatic preparation of cards as a by-product of typewriting, and we can look forward with confidence to this principle being applied in many directions. The clocking in of workmen will no doubt produce the punched card for the preparation of wage bills, and the costing of time expended on various jobs. A beginning has been made in the book selling and library service of issuing a punched card with each book for subsequent return to the central publishing house, in order that statistics can be collated of sales and issues. There is no saying that the gas and electricity meters of the future will not produce automatically a punched record of consumpt, already stamped and addressed to the company, which the consumer will put in the pillar box in order to produce the monthly or quarterly account.

The automatic preparation of a cheque in discharge of a supplier's credit balance, and the automatic rendering of an account in respect of a debtor's debit balance, as a by-product of the posting and automatic balancing of a firm's accounts, are logical developments of the present stage of progress in the punched card art.

The enormous capacity of the punched card machines, their basically sound principle, the unlimited opportunities for analysis, their high degree of accuracy and flexibility, not /

not only on their own account, but also in their capacity to marry with other mechanical and non-mechanical (e.g. colour) principles, and their power to preserve a strict order desired, or re-arrange it, suggest realms of application yet undiscovered. The practicability of cards being punched at various branches and sent in for complete tabulation of results at the head office has already been proved by the Imperial Tobacco Company (of Great Britain and Ireland). This principle alone will widen the economic field of application very considerably, as multiple and associated businesses are on the increase. The existence of such a dynamic system, for social circumstances themselves dynamic, may yet render a continuous economic history of the activities of our times. It may well be that the historian of the future will have to master the technique of the punched card.

[Con]clusion. The principle of registering - not by writing, but by cutting notches in a stick to represent definite values is as old as history.

The growth in the size of the business unit has, however, created a very definite demand for something infinitely better, and the punched card principle is the answer.

The growth and aggregation of office transactions has tended to create peak loads. Perhaps no office machinery is /

is more capable of coping with peak loads than punched card machines, by reason of their speed and the minimum amount of staff attention which their operation entails. The normal methods of coping with peak loads of work, however they may be caused (e.g. holidays or incoming work) are inherently weak. A temporarily augmented clerical staff means the introduction of a less experienced personnel at a time when pressure itself tends to increase liability to error. The difficulty of training temporary staff during a busy period often makes this method more trouble than it is worth. A floating staff is not always an economical proposition, while the employment of existing staffs on long hours of duty tends to considerable loss of efficiency when the need is greatest.

While the punched card installation is, by reason of its cost and capacity, essentially for larger firms, there are still numerous firms of lesser magnitude which are able to avail themselves of the facilities afforded by such an equipment, through Service Bureaux which will undertake calculating and tabulating work. In such cases, adequate and expert staffs are available for special occasions, or even to cope with the overflows arising at peak periods. There are many occasions on which periodic work, such as dividend payment, throws on the permanent staff a considerable strain /

strain which might oftener be met, with all round advantage, by giving the work out. Additional temporary staff have a habit of digging themselves in.

Samuel Butler once wrote -

> "Whenever precision is required, man flies to the machine at once as far preferable to himself. The machine is brisk and active when the man is weary; it is clear headed and collected when the man is stupid and dull."

The term "almost human" so often applied inequitably to the punched card machine, takes little account of the liability of humanity to err and of the reliability of this method. The punched card principle does not eliminate the element of error, but it does locate it to the punched card itself.

With the larger organisation of to-day involving much delegation of responsibility, detailed and comprehensive statistics must very largely take the place of personal supervision. Innumerable cross sections of society and of business activity can be secured economically by the punched card. Numerical magnitude in the number of transactions to be handled is not the sole criterion for the economical application of this type of machinery. There is the important consideration of the number of angles of approach to the punched information which can beneficially be utilised. The census information is a case in point. Not only is information of the population required for the various cities and counties, but this same information is analysed /

analysed by parishes, age groups, occupations, industries, according to size of house occupied, and so on. Some twenty-six different and distinct angles of approach are obtained from the one card which is as adaptable from the one angle as from the other. This is an advantage which can be claimed for few, if any other, systems.

The following quotation from a recent article by Addison Perry Keene, Cost Comptroller, Austin Motor Co. Ltd., affords a further illustration in the economic sphere:-

> "While in 1907 we turned out with considerable effort 22 cars per week, we make now every day of the week more cars than that before breakfast. The result is that to-day we can sell a car at a profit at £260 against a loss at £860 in 1921. How is this done? This is where the office comes in. There are 6,800 parts in an average Austin car, and in those 6,800 parts there are 107,000 operations. For every part and for every one of those operations there is a predetermined price for time and material. Not one of those operations is allowed to surcharge its neighbour, each one must make its own profit. How do we know it does? There is this advantage with the modern tabulating and accounting machines, that one can command an extraordinary analysis. We can obtain more than 1,400 verdicts a minute. The punched card we use points automatically to the exact place and cause if there is an error, or if the profit that you should wish to extract from the article is not being made. We can correct faults whilst they are happening. About our works there are punching stations, also portable machines; and as production operations develop, the office begins to come in with active criticism. There is with each line of /

> ofmachines one office man and one inspector. The moment anything is detected as departing from the plan, the buff card becomes another colour - red. This is like a fire signal to the executive. But the machine is not content merely to say that something is wrong. The analysis that it brings forward says that is wrong."

Thus may the light shine "through holes yourselves have "made."

CHAPTER VI.

Mechanisation in relation to the Size of a Business.

"Non enim potest quaistus consistere si eum sumptus superat."
Plautus - Poenulus I, 2, 74.

Introductory.

The value of any asset to a business depends on its contribution to the future receipts or on its lessening the future expenditure of that business. On these grounds alone can the economic application of office machinery to any size of business be equitably judged. It is so often stated that office mechanisation is mainly for the large firm. Such a contention is no longer tenable in view of the variety and flexibility of many office machines. While there are single purpose machines performing only a fraction of a complex business transaction for those who can profitably employ them, there are also machines which will successfully undertake such diverse jobs as invoicing, ledger posting, sales analysis, preparation of cash receipts, cheque writing, wage sheets, and many other tasks, with the desired number of copies and appropriate simultaneous combinations. Extensive office mechanisation is for the extensive firm, but intensive mechanisation is being applied with equal success in countless small businesses to-day. Mechanical /

Mechanical devices are essentially contrived to do repetitive operations, but repetition is of "genus" and rarely of fact. Accordingly, elements of repetition must be looked for, and, in not a few cases, deliberately planned for, by sub-division of operation, analysis and classification, and, in the case of dispersed business, by bringing the work to the machine rather than taking the machine to the work. It is only economic to substitute expensive instruments for the labour of human hands, where a number of such routine tasks are controlled under a single management and a single roof, and where there is a valuable quid pro quo for the labour thereby saved. While the economics of the problem undoubtedly impose quantitative limitations on office mechanisation, there are also qualitative limitations. The competence of machinery is confined to operations based on routine, however indefinite that may be. Shrewdness and judgment, capacity for bargaining and compromise, are, and will always remain, the prerogative of the best business minds.

ize is a factor in office mechanisation.

In the light of developments during the past fifty years, it would be difficult to lay down any hard and fast lines as to the size of business in relation to office mechanisation generally, because in the last resort the factors which determine the scope of machinery are functional /

functional and dependent on organisation rather than on the mere nature and size of the business.

In every office there are limits to the use of mechanical aids, and these limits have to be recognised often by painful experience. There may be much of office work of a personal nature in which the division of labour, essential to mechanisation, is neither appropriate nor workable.

On the other hand, there are a number of machines like the typewriter, the cash register and the duplicator which have come into such general use, because of the universality of certain specific operations which lend themselves to delegation. Moreover, the many special purposes machines now available to perform specific tasks make possible in an infinitely varying degree a mechanisation which is a process rather than a result, without any conscious or deliberate planning to that end. Whole office systems can be built up by the complementary use of several such machines. One firm alone (Burroughs) produces over 450 different keyboard machines with more than 2,000 optional features, and within limits machines are assembled to suit particular requirements.

ut there are other consider-ations.

Notwithstanding this elasticity in manufacture which brings with it a considerable elasticity in use, the high capital cost of intricate machines involves an important addition /

addition to overhead expenses, and the extent or degree of mechanisation will in general depend on certain recognisable factors such as:-

(a) The ratio of overhead expenses to total expenses.

(b) The ratio of routine office work to total office work.

(c) The nature and degree of functional concentration.

(d) The common ground for the grouping of operations - simultaneous preparation.

(e) The broad lines of business organisation - branch v. self-contained subsidiary.

(f) The ratio of irreducible spare "staff time" arising from other activities.

(g) The degree of disturbance to traditional methods of operation.

(h) The importance of stock records and costing.

These factors will be considered in greater detail later, but it may be pointed out that a questionnaire addressed to the more important office machinery firms on the question of the nature and size of business regarded by them as "prospects" yielded quite indefinite results. ~~Some of the answers given to this part of the questionnaire are given in Appendix No.~~ . Notwithstanding these difficulties, certain office machinery firms have actually surveyed their various territories and formulated certain guiding principles as to the capacity of various sized firms to absorb their products.

Another /

Another prevalent notion that machines, to be economic, must be fully employed, is moreover only a partial truth. If this were not so, few would be the duplicators, postal frankers, cheque signing, letter opening, and a host of other machines in use to-day. Yet there is an ideal "load" for the economic employment of almost every office machine. It is not always possible to isolate the specific operation and the machine in order to arrive at this load. Moreover, a trifling assistance during a critical period may be of much more value than a consistent service under normal circumstances.

It may well be of supreme importance for a business that the morning mail should be opened and scrutinised before workmen or salesmen leave on their daily rounds. Every minute saved on this operation may effect a saving multiplied many hundreds of times by the many employees awaiting their daily instructions. An electric letter-opening machine costing £45 and used for five minutes every day may be justified in such circumstances. Similarly, the use of a postal franking machine which enables a peak load of correspondence mounting up at the last hour of the day to be expeditiously despatched nightly without any overtime, must be considered in reference to the value of /

of such promptitude in relation to the nature of the business. In the case of a bookmaker, for example, the forwarding of winnings with next week's coupon is the essence of the organisation, and the recognised basis for the conduct of the business. Accordingly, we find such firms fully mechanised with machinery which may be used during only a fraction of the day. The aims of directors to have the dividend warrants on the breakfast table on the day following the company meeting are only possible of achievement through mechanisation which may only be intermittently justified. Certain machines may be idle for longer periods than they are in operation and still pay their way.

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An important consideration in determining the degree of office mechanisation which will be economic is the ratio which overhead or indirect cost - which embraces the cost of office work - bears to the total expenses. It will be readily realised that where the cost of the office work represents only a very small part of the total production cost, there is very little margin in this sphere of operations for effecting economy. It may be that other considerations, such as the volume of turnover, will afford grounds for effective mechanisation, so that infinitesmal savings multiplied many thousands of times may justify a considerable /

considerable capital outlay. General expenses or overheads, as pointed out by Sir William Ashley (Business Economics, p. 21), by reason of the fact that they are general, are often difficult to ascribe to each unit of output. Schemes of apportioning them may evolve a considerable amount of overhead expense, unless steps are taken to effect this necessary operation with the utmost economy.

There is also the nature of overhead expenses to be considered. Where these partake of the nature of fixed expenses, irrespective of the output, then there is not the same urge to mechanise. Where, however, the clerical costs tend to grow in some ratio directly associated with turnover, the need for considering office mechanisation may become an urgent matter, particularly where there is effective competition for the product of the industry. Some undertakings by their very nature involve very high overhead expenses. Take, for example, the undertakings distributing gas, electricity. The cost of gas into holder in Edinburgh in 1937 was under 1/- per 1,000 cubic feet, but, in order to sell this gas at a price to clear all overhead expenses, this is charged to the consumer at an over all average price of 2/5. It is instructive to see where this difference emerges (Appendix No.31).

It is no mere coincidence that such organisations are very highly mechanised.

The /

utine office work: total office work.

The class of the office work, perhaps more than its actual volume, is also an important consideration in the nature and degree of practicable office mechanisation. An enquiry department, for example, where the unit of business originates outside the scope of the office, and may be of such an individual character, usually creates a most difficult problem for office machinery. Where enquiries are dealt with by correspondence, single purpose machines, such as letter-openers, duplicating machines, postal frankers, may be used extensively. Again, where enquiries give rise to estimates, suitable accounting machinery may be employed with success, provided a sufficient volume of work is available. But generally, by the time the individualistic aspects of enquiries have been disposed of, the work of the department has been very largely accomplished. Salesmanship and retail distribution may be cited as examples of work which does not lend itself to very effective office mechanisation, except in the <u>ex post facto</u> sphere of accountancy. There are certain types of office work which even in considerable aggregates do not lend themselves to particularised mechanisation, although schemes can often be effectively evolved for the rest of the office work.

Another point of importance when assessing the ratio of /

of routine work to total office work is its incidence in point of time. There may be a considerable amount of routine office work capable of ready mechanisation which only emerges in small quantities at one time, but which must nevertheless be disposed of in order to enable other work to take its normal course. In some cases, it will be an economic proposition to have a machine reserved and set up for coping with this incidental routine work, but in many other cases it would be quite out of the question to mechanise such routine work. As an example of the former case, the preparation of drivers' licences demanded at Local Taxation Offices may be quoted. Here the spasmodic work has been successfully mechanised in Edinburgh by having a continuous roll, automatically fed, flat bed typewriter, continuously set up for the immediate preparation of these licences, with consequential improved service to the public and savings to the Local Taxation Department. Even in cases where mechanisation of incidental routine work is out of the question <u>per se</u>, it is nevertheless advisable to bear this work in mind when deciding on machinery for other purposes, in order that, should occasion arise, it would be advantageous to be able to elect this alternative.

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ictional concen-tration.

It might well be stated as a fundamental principle that the degree of functional concentration and not necessarily the size of the business is the factor of importance in determining the extent of office mechanisation. This may involve a detailed analysis of all office work with the object of ascertaining how far arrangements may be made to bring together analogous operations so as to make mechanisation worth while.

It will readily be realised that an arrangement of subsidiary companies where each firm is more or less a self-contained unit represents a different kind of problem from that of a highly integrated organisation where only physical distribution of products takes place at branches, and all the major records are concentrated at one headquarters. A comparison might appropriately be made between the Post Office Savings Bank and the branches of the Joint Stock Banks in Scotland. In the case of the former, all records are concentrated at the London Head Office, while only unit transaction documents are prepared at branch post offices for subsequent recording at headquarters under a highly mechanised system. In the case of branches of joint stock banks, the complete records are kept in self-contained branches, where in many cases the numbers of transactions do not justify any extensive mechanisation. The problem of determining the degree to which centralisation or decentralisation of functions should appropriately be /

be carried continually arises in business. Opposite treatment of different functions may be necessary in a change of circumstances, and principle and practice may be difficult to reconcile. On the one hand, delegation may have the effect, not only of having the retained functions better performed, but also of having the delegated matters also executed more efficiently. On the other hand, the concentration of any one function may facilitate the economic application of machinery so as to secure maximum net advantage, even if this necessitates the delegation of some other function to a less competent person. The extent to which this devolution, and mayhap consequent determination, may be carried is the minimum quality of performance to be tolerated. It does not follow, however, that concentration of one function and delegation of another will result in the deterioration of either - improvement in two dimensions is equally likely - but new problems of co-ordination may emerge. Provided the costs of the co-ordination resulting from this change in organisation do not outweigh the savings in other directions, there will be a net advantage.

There are, however, certain conditions necessary for successful delegation. The success will be least where the personal qualities of the performer are of paramount importance. Fortunately perhaps, such personal qualities do /

do not enter into the normal performance of routine clerical operations, but, on the other hand, they certainly do in the case of the higher administrative officials. Hence, there is all the more reason that the management should be relatively free to decide. The same is true of accountancy: there is much of a routine nature, but on the other hand there are many decisions of principle to be taken in respect of separate transactions, and such matters cannot appropriately be delegated. The horns of the dilemma are very pointed. On the one "the gains from "specialisation need no emphasis" (Arnold Plant): on the other "the function of the management is to decide", and where the management is, there must also be the decision.

mmon round.

Functional concentration has a further significance in that it can often be carried further than at first sight is always apparent. The grouping of operations of a similar character will often lead to the simultaneous preparation of matter common to transactions emerging at different stages in the cycle of operations, even although some of these transactions cannot be completed by mechanical means, at least at the same time. The extent to which common ground can be found has a great bearing on the degree to which office mechanisation can be carried economically, and in the type of machinery which is most appropriate for the purpose. The developments in the simultaneous /

simultaneous preparation and part preparation of office records have repercussions in the amount of checking work and audit. Even very small businesses may successfully adopt schemes for the simultaneous preparation of delivery notes, invoices, accounts and ledger entries, where the volume of these, prepared consecutively, would scarcely justify the purchase of the machine. The savings from simultaneous preparation may be considerable. A new example - the first in Great Britain - has recently been introduced into the City Assessor's Department in Edinburgh, where Valuation Roll, Assessment Ledger and Demand Note for Rates are being (partly) simultaneously produced at one operation at an estimated saving in staff of £2,000 per year. Here, too, the preparation of survey books is done by the same plant. This serves not only its primary purpose of a survey book, but also affords an opportunity for checking the accuracy of these combined entries which are to be done at a later stage in the cycle of work.

The following tabulation shows a typical grouping for one accounting machine:-

ONE/

ONE MACHINE

can do all this accounting work

Operation 1	Operation 2	Operation 3	Operation 4
Billing of Electricity Gas and Water Charges	Cheques	Receipts	Rate Demand
	Order on Treasurer	Cash Book	Valuation Roll
	Bank List	Bank Pay-in Slip	
Summary of Charges	Committee Schedule	Ledger Posting Slip	Assessment Ledger

ganisation. The broad lines of business organisation rather than the mere size of the business is also a matter of importance in determining the extent of mechanisation. Reference has already been made to the geographical distribution of self-contained branches in contra-distinction to concentrated headquarters recording. It may be pointed out that conscious appropriate organisation should precede rather than follow office mechanisation if the utmost benefit is to be obtained from expensive equipment. The term "conscious" has been used advisedly, because, as so often happens in British business, an organisation has just grown up with the development of the business, often from /

from very insignificant beginnings. Fundamental re-arrangements may, therefore, be necessary as a condition precedent to mechanisation, in order to bring together the requisite volume of transactions capable of mechanical operation. Departmentalism may mean quite a different thing under a mechanised office scheme than it may do where manual methods only are employed.

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ime.

One of the objects of the introduction of office machinery is the saving of staff, labour being expensive. As often happens, operations which are quite capable of being effectively mechanised come haphazardly among activities which require the attention of the individual. Where the incidence of such operations is not subject to the control of the business itself, and an irreducible minimum of staff is necessary to deal with the activities which do not lend themselves to mechanisation, no economy may emerge from such mechanisation. The only effect might be to enforce idleness on individuals who must wait for the next call on their services. An example of this kind was recently brought to notice where the addressing of monthly programmes to cinema patrons was carried out by cash desk attendants between times taken up in serving the public. Such addressing could much more effectively be done by addressing machinery, but the installation of this would be /

be but an added expense, unless the cashiers could be better employed between times on some other occupation. This example goes but to prove that the economic application of machinery to office work has to be considered in the light of the particular circumstances of each case.

raditional methods.

It has been said that custom has conferred on mankind the benefit of perpetuating best methods of doing things, in the light of all the circumstances. While Taylor was at great pains to prove in his treatise on Scientific Management that "best" was only relative and that by time and motion study improved methods were not only possible but as easy as they were startling, nevertheless the force of tradition is very real, and in the absence of convincing reasons to the contrary is a reasonably safe guide. The innate conservatism of the British people is universally recognised. The fact that they have very largely succumbed to office mechanisation affords very good grounds for the belief that it has established itself on economic grounds. Reverence for traditional methods is seen in the more universal favour with which typewriters and duplicators have been accepted by the British public than the more revolutionary, but no less effective, punched card art. Whereas the former causes little or no disturbance to traditional /

traditional methods of conducting clerical operations, the latter involves a complete change in outlook in regard to the basic methods of recording. The proverb, "Autres "temps, autres moeurs" requires many pages of history before it has much significance for the business man.

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d costing.

The nature of the business, rather than its size has a considerable bearing on the extent of office mechanisation. In the newer industries where traditional methods have had little time to entrench themselves, where the tempo of development is much more rapid, and where the products themselves are essentially the outcome of rapid scientific development, there is a more marked tendency to keep the office activities on the most progressive lines. Radio, motor car, chemical, and certain of the textile industries are cases in point. In these instances, stock has a rapidly varying value. Stock recording is an essential feature of the business, and there is generally scope for the application of one of the many machines designed for this purpose. Stock recording is essentially routine work. It occurs with some measure of constancy day by day, lends itself to the adoption of those facilitative measures (loose leaf, etc.) which make mechanisation readily effective, and affords opportunities for a balanced financial policy. Direct economies in staffing, indirect economies /

economies in stock keeping at reasonable levels, and accuracy in recording and proving, readily appeal to the imagination of the business executive, already alive to changes in technique and variations in demand. Accordingly, we find that very material progress has been made in the application of machinery to this type of work even in businesses of modest size.

When allied to a costing system, the advantages of proving daily that all issues from the stock ledger have been duly accounted for in the cost ledger will be readily apparent. Cost accounts which are not "proved" in this way may be of little assistance in "taking the bandages off the eyes of the directorate". It may be pointed out that costing has become very much more fashionable in recent years. This is due to a combination of causes. Firstly, the availability of effective machinery for accomplishing it at reasonable expense. Secondly, a changed attitude in making available over a wider sphere the results of such costings has stimulated the preparation of other costings for comparative purposes. Vertical or horizontal comparison is useful to the firm practising it, but where comparison can be made horizontally with others carrying on similar operations over the same periods, a great deal of important information may be obtained, and the justification for extensive costing is enhanced. The general movement towards /

towards mass production with consequent development of satisfactory "units" for costing has stimulated the practical field for this form of administrative control, but there is room for improvement in the scientific use of such facts which are often costly to produce and too often are not justified by the use to which they are put.

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Mere size of a business is only one factor in office mechanisation, and even this must be regarded comprehensively. It is often more practicable to work from the machine capacity back to the business. To take as an example a consideration of installing a punched card installation, it is useful to ascertain how many "card uses" are likely to arise in the course of a year. By the term "card uses" is meant the aggregate of cards multiplied by the number of uses made by each. This might be expressed by the formula -

$$c \times n$$

where c represents each card employed and n the number of times each card is used. In order to ascertain this information, the following typical information would require to be ascertained:-

(1) The number of employees x number of pays per annum
x Income Tax postings
x Superannuation postings
x Costing allocations.

(2) /

(2) The number of stock transactions, inward and outward, the number of stock balances required.

(3) The number of direct charges.

(4) The number of ledger postings -
(a) Purchases
(b) Sales
(c) Balances.

(5) The number of invoices and accounts, inward and outward.

(6) The number of cost ledger postings and balances.

(7) The number of cash transactions - inward and outward.

Where c x n is less than one million per year, it would be difficult, in the absence of special circumstances, to justify the installation of a punched card system. Such special circumstances might, however, put an entirely different complexion on the situation. For example, if the preparation of cards for certain transactions constituted a means always available for prompt preparation of a record which must be completed in a specified time, and only alterations required to be made from time to time, the case for such an installation may be fully justified.

Conclusion.

The title of this chapter might be thought to suggest that office mechanisation is largely a question for the foot rule or other equally simple means of measurement. The matter is not so simple. The title might, with equal /

equal justification be rewritten as "The size of a "business in relation to mechanisation". Direct economic considerations can never be left out of account. A small office may have its needs met by the provision of one typewriter. It would obviously be wasteful to install a book-keeping machine where the whole of the clerical work can be carried out by one person. Mechanical aids should not be installed unless there is a definite use for them and a definite saving may reasonably be expected to emerge which will at least meet the cost of the depreciation on the machinery to be installed. Subject to this broad principle, mechanical aids may be as vital to the small firm as to the large organisation.

The size of a firm is severely limited by the number of functions which cannot safely be delegated. The essential conditions for the growth of a business are standardisation and the possibility of organising production on adaptable machinery with consequent speed and increase of output. The dominating fact is the limit to the working day of the head of the business. Much of his time must be taken up in ascertaining the relevant facts of each situation, and in pondering the probable effects of alternative policies. If he is not left with sufficient time for these, his especial functions, he will either need to work by faith, or contract the scale of his operations /

operations. Standing orders may cover a multitude of sins, but rigor mortis may ensue from the application of rules and precedents which are no longer appropriate under dynamic conditions. Firms expanding their scale of operations are, therefore, compelled to concentrate more and more on the kind of output which can most safely be standardised, even if this involves the buying in of items which otherwise could be a domestic matter.

Large scale operation has its advantages as well as its weaknesses, not the least of which is, on the other hand, the growth of specialisation in high quality management and, on the other, the problem of internal co-ordination. Management and co-ordination will probably continue to race each other with new techniques and new mechanisms throughout the ages, but neither can for long get much ahead of the other. The greater the size of the firm, the greater will be its power to control market prices and to develop specialisation of staff, not only in routine operations, but also in the wider sphere of finance, production technique, sales promotion, and buying and warehousing. These considerations in themselves afford opportunities not otherwise available for the application of machinery and equipment of a specialised type.

Unfortunately for the organiser, a table cannot readily be prepared showing the number of types of machinery appropriate /

appropriate to the various sizes of business. All the circumstances must be taken into account, even although the bearing of some of these on the question of mechanisation may not be readily apparent. An attempt has been made to indicate some of the significant considerations, but experience is the best guide in such matters. It might appropriately be stated that "size" gives prima facie grounds for an enquiry into office mechanisation, but that consideration must also be given to the circumstances and organisation of the trade and of the particular business with special reference to the necessity for certain office records and the available margins for economies in their preparation. Efficiency at the head office must be reflected in efficiency at the branches. Thus, the system of mechanisation must be considered in the light of the business requirements as a whole. Too little regard is often paid to the enhanced difficulties of branches through the centralisation of records at the head office. Economies secured at the sacrifice of branch efficiency are rarely, if ever, justified.

With certain specific office machines, scales have been worked out on the basis of staffs, number of accounts, etc., in an endeavour to show when mechanisation will be an economic proposition, other things being equal, but the line at which the change can be made with advantage depends so /

so greatly on the considerations here outlined, that no good purpose would be served by their further specification.

While "size" of a business unit creates the appropriate atmosphere for mechanisation, the deciding factor in most cases is an adequate volume of routine work requiring little or no mental effort and which therefore can be performed more accurately, more economically, and with greater expedition by machinery. Just as the laws and conditions of supply and demand must be regarded together when approach to practical conditions is made, so in regard to office mechanisation in relation to the size of a business the mutual relationships of these two must be recognised.

It may well be that many big business concentrations might find it profitable to "unmerge" themselves into smaller units. If it is true that capital seeks profit, and if it can be demonstrated that under certain circumstances capital can find greater profit through operation in smaller units, then, under those circumstances, capital will break up voluntarily. No business should be so big as to threaten the free competitive democratic order or to fail to profit from the best established practice whether this be by mechanisation or not. It should be no bigger than it needs to be: it should be compatible in size with its technique of management, and commensurate with /

with that of the incentives to those who operate it. There is a relative optimum size for every business, rather than an absolute one, and, inasmuch as mechanisation is a factor in the technique of management, it is an important consideration in determining relative optimum size.

CHAPTER VII.

Some of the Consequences of the Introduction of Office Machinery.

> "Efficiency is as much concerned with turning out good work as it is in saving time." Knoeppel.

ntroductory. In previous chapters, some of the major effects of office mechanisation have already been considered as a guide to the application of specific machinery to routine clerical operations. It is, however, desirable to distinguish between the general advantages or disadvantages of the concentration of clerical work in larger offices, a necessary precedent to mechanisation, and mechanisation itself. It is also desirable to distinguish between the change of attitude which mechanisation brings about, and the essential achievements of the machinery per se, and this can best be done at a little distance from the theatre of operation.

> "It is sometimes suggested that the introduction of expensive office machinery is worth while, not because the machines justify their cost, but because they cannot be used until the whole office procedure has been surveyed and planned afresh." ("The Accountant", 3.11.38).

The economic advantages of large scale production are sufficiently well known to require no reiteration here. Similar advantages also emerge in the case of office work by /

by reason of the relative efficiency of office machinery.

The saving of time.

A test was recently made on the relative speeds in calculation and addition between the machine and the ordinary method. The test was in two parts - a simple addition of ordinary figures and a second addition of £ s.d. The total number of digits in these tests was 1,235. The time taken for these additions by the machine was six minutes. The time taken by the clerk without mechanical aid, was 23 minutes.

Apart from the saving of time thus disclosed, it will be obvious that the mental effort required of the machine operator was neither so strong nor prolonged as was the case with the clerk.

A different kind of test was then performed. This test consisted of ten different calculations, ranging from so many yards of material at so much a yard and the compilation of simple interest, to the conversion of currency at varying rates to sterling. The time taken to do these calculations by the calculating machine was 11 minutes. The time taken by the clerk was 40 minutes.

It will, no doubt, be appreciated that the mental strain upon a machine operator at the end of a day is considerably less than the mental strain upon a clerk who has to carry on with these calculations all day and every day /

day. Furthermore, it must be borne in mind that with increasing mental fatigue, the clerk is bound to slow down with his work towards the end of the day to a far greater extent than the machine operator.

With certain book-keeping and billing types of machines the further advantage emerges that, as the postings are completed, summation and balancing is also solved, while with tabulating and statistical machines, minute analysis and an enormous amount of detailed information can be produced in a very short time with the minimum amount of conscious effort, and records are always up to date and in balance.

Machines (subject to certain adjustments) can only be operated one way. There are rules for most activities in society. Some are rigid, others flexible, but the more flexible the rules, the greater is the liability to disorder. Machinery imposes rules with a fairly firm hand, and tends to standardise the rules, with consequent improved order in business.

The quality of accounting.

A writer in "The Accountant" (2nd January 1937) said that the quality of accounting was much better to-day than it was ten years ago. This he attributed partly to the growth of large scale administration with all its advantages of specialisation and appropriate selection of individuals, and partly to the improvement in commercial education. To the significance of the advent of the machine /

machine he refers in the following terms:-

> "The advent of the machine as co-partner with the business element in the performance of book-keeping tasks has exercised a profound influence. The achievement of arithmetical accuracy is the least part of this matter, for to our mind the beneficial effect of the machine is to be recognised in its insistence on ordered routine as a necessary preliminary to and concomitant of its employment. The ordering of routine brings in its train the liberation of the mind for tasks demanding intellectual freedom and originality, and in a word man power, becomes more nearly the equivalent of brain power."

This quotation has peculiar significance at the present time when, with a falling population, it is of the utmost importance to conserve the man power of the nation for the essential services of discerning administration. Demographers to-day are becoming more and more conscious of this aspect of social phenomena.

It is almost a platitude to say that many of the difficulties in routine accounting and auditing are due to errors in reading and writing of figures, and it would be impossible to assess the time wasted in locating and correcting the misinterpretations due to this cause. The present tendency of education is not conducive either to the production of good writers or particularly facile counters, and this is an important factor to be reckoned with in the commercial world. Subject to correct manipulation, the records produced by machinery are models of clarity and order/

order. Correct placement of figures is automatic, and repetition where desired is equally so. Further, as recopying is reduced to a minimum through the use of carbon paper and various stages of posting can be done at one operation, the opportunities for clerical errors are relatively few. The analytical capacity of modern machines of self-proving type does away with the need for keeping many subsidiary records hitherto regarded as indispensable, while the search for the best machine methods has brought about a greater measure of uniformity as between one firm and another than was ever attained under the manual methods of half a century ago.

It would, however, be misleading to assume that it is only in the realm of accounting that the greatest advantages are likely to accrue in mechanisation. Automatic accuracy, speeding up, the elimination of errors in names and addresses and other important details, the obviation of delays in misdirection of consignments, are but some of the advantages effeiring to the installation of an addressing plant which can also function as an effective and selective check on the activities of various sections of a complex organisation. At the same time valuable time of employees who are capable of doing service which no machinery can undertake is thereby saved.

The /

Cross-referencing facilitated by mechanisation.

The importance of adequate cross-referencing in organisation can scarcely be over-emphasised. The ease with which any transaction can be traced forward or back, not only results in a saving of considerable time, but the presence of such an effective system has a salutary effect on the integrity of the accounting. Mechanisation does not always get its full credit for this aid to administration.

The extent to which adequate cross-referencing is facilitated by mechanisation is very marked. A system of permanent referencing on address plates will ensure the accurate repetition of such information on every occasion where this is desired. Even where repetition of such a reference number is not entirely automatic, the majority of accounting machines now provide facilities in non-additive positions for the inclusion of such reference numbers as may prove desirable. From the inception of a transaction on, say, a works order, through cost and stock ledgers, personal accounts, and even to the receipt of cash in payment thereof, modern machinery will meet most requirements of executive and auditor.

By means of an automatic numbering attachment incorporated in many machines, serial numbers can be allocated to entries as they occur.

The use of numbers instead of names is also helpful when /

when there are many entries of the same character or name, such as "Smith" or "Brown". The allocation of numbers in the heading up of statements is also desirable, because the operator's work is facilitated when referring to numbers rather than to names.

There is a tendency nowadays to eliminate references wherever possible, using the date for identification purposes and keeping accounts according to their nature in alphabetical or numerical order. On the other hand, there are many cases where cross-references are absolutely essential for office purposes. On the non-narrative type of machine, coding is necessary for mechanical reasons, thereby eliminating a considerable amount of time and labour previously spent in writing full descriptions.

A line and sheet reference number is, for example, an easy means of reference on Electricity or Gas Accounts to the simultaneously prepared ledger sheet, while another instance which might be given of the use of a reference number as facilitating an appropriate machine division of labour. In one of the largest commercial firms, individual employees' savings accounts are kept by machine, but the heading consists of a number only. The monthly statement is prepared and balanced simultaneously with the ledger account on a machine which is not designed for a typewriting function, and at the end of the month passed to /

to a central addressing machine department where the statements are headed up with the individual employee's name and department. In this way, the ledgers which are more or less open for all to see, give away no information in regard to an individual account.

uditing. Mechanisation has created new problems for auditors, while at the same time it has greatly simplified many of their problems. In a recent publication on "Standard Practice in Auditing", W. J. Black states:-

> "It is a general principle of law that a professional man who holds himself out as being ready to perform services for reward thereby gives an implied guarantee that if the work is entrusted to him it will be carried out competently and with the exercise of reasonable care and skill. It follows therefore that the professional man must keep himself advised of current developments in business practice."

It is therefore inevitable that the auditor should know the methods of mechanisation in use in the preparation of the accounts he examines. As his work may involve scrutiny of many businesses, he cannot well avoid a fairly extensive knowledge of all recognised methods particularly with reference to the proof of accuracy and internal check available through use of the machines.

There are particular features of importance to auditors

(a)Codification. in mechanised systems, and these may be examined. The use of /

of machinery may necessitate extensive codification and before an intelligent understanding of entries can be arrived at, acquaintanceship with the code is necessary. To an employee of one particular business, this presents no undue difficulty, as familiarity eventually brings about ready recognition. To the auditor, however, who has to pass from one business to another, the opportunities for becoming familiar with the details of codification of various firms are so much less that this codification may be a real hindrance to auditing progress. It will be found that where a detailed codification has been in use for some time, there is greater consistency in the allocation of expenditure to particular accounts with consequential improvement in the comparative value of accounting results. In the interests of speed, narrative is generally reduced to a minimum. It should be borne in mind that a judicious use of appropriate ledger folio headings and separate folios for all entries of a class may greatly minimise this disadvantage. This subdivision of otherwise composite ledger folios has also considerable use for purposes of proving accuracy. For example, where a particular series of cost accounts are being prepared, it may be profitable to run the cost accounts in different series - Pink or (a) for wages, Green or (b) for materials, White or (c) for direct charges, and Blue or (d) for oncost charges /

charges. In this way, all the pinks should total to the wage bill, the greens to the store ledger, the white to direct invoices, while the blue folios should in the aggregate agree with the total overhead costs. This subdivision has proved very practicable in many known cases.

) Accuracy. While accounting machinery enhances the legibility and accuracy of accounting records and enables the auditor to assume a greater degree of arithmetical accuracy, the mere introduction of machinery does not relieve the auditor of any of his obligations, particularly in regard to errors of principle. He must in all cases obtain evidence of accuracy where he decides to omit exhaustive checking, and this he can usually secure more readily from machine posted records through the additive and analytical features of the machines. He must, moreover, require all the explanations he considers necessary. Machines can on occasion be manipulated, and transactions can be omitted from the usual routine channels for nefarious purposes. Accordingly, the auditor must have sufficient knowledge of particular machines to detect the methods by which records may be manipulated. An important feature from the auditor's point of view is that under certain systems the operator must quote against each posting the serial number of the account to which the posting refers. Thus, all the entries in Account 20115 should bear this reference against them. If /

If a posting has been made to the wrong folios the auditor is greatly assisted in spotting it.

Errors. Notwithstanding the greater degree of accuracy, there are certain disconcerting features for the auditor in machine accounting records. The more intimate knowledge associated with hand posted ledgers and the proclivity of clerks remembering many of the particulars of transactions out of the ordinary is often of material assistance to the auditor, but this intimacy tends to disappear under machine posting. Even greater reliance, therefore, must be placed on the self-explanatory nature of the records themselves.

It is useful for an auditor to be conversant with the types of error which may occasionally be found in such records, and the following examples are suggestive:-

(1) Old balance picked up wrongly twice, thus proving entry correct in spite of wrong balance brought out. It is usually found that figures have been transposed, e.g. 4285 for 4825.

(2) Carry forward not taken to new sheet.

(3) Total of entries taken to wrong control account, thus making both ledgers wrong.

(4) Balance picked up twice at beginning, making the new balance and proof column wrong, The proof column may subsequently be adjusted to the correct figure, but the new balance not changed.

(5) Debit entry treated as a credit, and credit entry treated as a debit, particularly after a "run" of debit or credit entries.

(6) /

(6) Entry put in at foot of previous folio where a new folio with balance already carried forwarded has been started.

(7) Entry posted to wrong folio within one control account and taken to correct control along with the other entries. (i.e. 45/1846 posted to 45/2846, but taken to Control 45.

(8) "Carry forward" taken from wrong side of page where ledger folios are posted on two sides.

(9) Totals of two or more control accounts taken to only one control account.

(10) Entry in wrong "register" with the consequence that the resulting entry is wrong, while the balance may be correct.

(11) Subtract key not operated in transferring total of run to control sheet with the result that the entry appears in the Control Account only but the amount sums into the following entry.

(12) Trip lever not pulled back into appropriate register when posting to credit balance with the result that at the end of a run an error of double the amount wrongly recorded arises.

(13) "£" key not fully depressed in setting up amounts of pounds only with the result that the amount registered may not be pounds. Non-add key may be depressed in error for "£".

(14) In transferring total to control, if subtract key is operated too quickly before the balance key, the answer is a row of "9".

(15) In posting even figures machines drops £1. £10. £100. etc.

(16) In transferring credits to credits, machine increases balance by 1d.

(17) Operation of wrong keys - i.e. balance key depressed instead of credit balance key.

(18) /

(18) Misplacement of decimal point in fractional calculations.

(19) Misreading answer in non-printing machines.

(20) Inaccurate key touch in certain machines.

Although this might appear a formidable list of possible errors (and there may be others), it must not be concluded that machine accounting is inherently inaccurate. On the contrary, it has taken considerable research to compile this list from a number of machines of different types and manufacture in daily operation, and there are safeguards often incorporated in the machine to obviate these mistakes being overlooked at the time of their occurrence. Such errors have happened and are merely put on record to assist the auditor, who must, on occasion, consider the error propensities of particular operators or machines, so that tiresome checking may be limited to the most profitable channels. The consideration of errors under a mechanised system naturally leads to the conclusion that the auditor of the future will require to orient his attention from much of the detailed checking now automatically done by the machine as a by-product of accounting and analysis work, to the more significant and effective control figures and cross checks which form the important feature of a mechanised system. It cannot seriously be claimed that mechanisation has solved the auditors' problem /

problem, but it undoubtedly has made possible the elimination of much drudgery, and faced the apprentice of the future with the necessity of learning something of the new technique of his profession.

The amount of routine work necessary to be done is further reduced by reason of the simultaneity of many machine operations. Hand methods involve more separate operations with the average degree of human fallibility and lead to more checking by the auditor. The various cross checks at frequent sections of the routine work and the minimisation of compensating errors are features of great importance to the auditor. In the vouching of the documents of original entry there may be little difference between hand and machine methods, but in the tracing of individual items to their final destination there is not the same necessity for meticulous checking, provided the system has been proved sound. It may, however, be that a day to day audit becomes much more of a necessity before the identity of particular transactions has become lost in a mass of mechanised detail, and before documents are re-sorted into a different order for some other purpose. The question as to whether certain forms of mechanisation comply with Section 122 of the Companies Act, 1929, is still not free from doubt.

A /

A new technique in auditing is, however, not a matter which can be developed in a day, and it may well be some time yet before we see a radical change in the approach to auditing problems.

) Speed. Provided efficient operators are employed, an audit in its preliminary stages at least can be completed more expeditiously, owing to the uniformity of transactions, the good figuring, the ready detection of any alterations and the many automatically determined totals and cross checks.

In a well designed system, machine entries are, with a greater regularity, complete in themselves. Automatic date, signature, classification, cashier, serial number, etc., given on a National Cash Register receipt, and foolproof audit totals, make the auditing of receipts a very simple and straightforward matter.

Further, the facility with which daily, monthly, quarterly and annual results are produced has enabled the auditor to maintain a better "close up" with consequent minimisation of the risks through fraud or loss. The mechanisation of accounts has also tended to reduce the arrears of uncollected accounts and thereby reduced the amount of detailed checking involved. Arrears, as is well known, are always a fruitful source of danger for the auditor, and anything which reduces them is of advantage.

The /

The very division of labour involved in mechanisation also constitutes an added safeguard, as complicity of several members of the staff always acts as a deterrent to misappropriations.

Apart, however, from audit considerations, the facility which mechanisation affords for speeding up of routine clerical operations is well known. Whether it be due to the design of the machine, its adaptability for daily balancing, etc., or its capacity for multiple function (posting and adding) and simultaneous operations, or whether the mechanisation has merely brought about an improvement in organisation and technique of machine methods, giving enhanced output, the results are generally forthcoming with greater expedition than under any other method. This is an advantage which may, in certain circumstances, be of inestimable value, particularly when coupled with proof of accuracy. It is desirable, however, that "mechanical" speed should not be considered in isolation, but as correlated to other factors involved. If a machine, once it has been set in motion, completes a transaction at a relatively slow rate in a way which enables the operator to proceed to the preparation of the next document, it offers equal, if not greater advantage, over another which carried out the intermediate transaction in next to no time but involves further attention before being ready for the

next /

next cycle. A chain is only as strong as its weakest link: it must be tested as a whole, so that "slowness", if it occurs at the right time, may be of no disadvantage in certain circumstances.

) Better ivision of unction.

Apart from considerations of appropriate division of labour as a safeguard against fraud the successful operation of a machine accounting system involves a better spread of responsibility, so that effective control of finance is considerably improved. Production of accounts and responsibility for their accuracy, dispatch and collection, for example, are entirely different jobs, and as an independent control proof is produced by each type of machine in the cycle of operations, manipulation becomes an extremely difficult matter.

The use of machines generally involves alterations in system, and the auditor will require to give some study to that system, particularly with regard to the frequency of check balances, cross proofs, and automatic additive features.

) The audit ay itself e mechanised.

The calculating and other machines installed in an office may also be at the disposal of the auditor to enable him to make such checks and calculations as he may determine to be necessary, thus eliminating much of the drudgery of audit. Indeed, he can now check many more transactions in a short time where formerly he had perforce to be content with /

with fewer sample checks. In this way the audit may be more extensive and thorough, while at the same time more time can be devoted to financial principles.

Efficiency of organisation and accounting creates a healthy atmosphere for business integrity. Efficiency and promptitude of audit maintains that atmosphere. If the types of machines in use are appropriate to the uses to which they are put, and form part of a well-planned and co-ordinated scheme, it may reasonably be expected that the audit will be the less costly.

The "Boss" is so often regarded as "fair game", not only by the office boy responsible for the stamps, but also by the workman who arrives ten minutes late, that postal frankers and time recorders may be regarded as auditors on the permanent staff. The fraudulent cashier who would manipulate protectographed cheques has also a very difficult task before him, and it is significant to observe that within recent years not a single fraud has been achieved in local authorities where mechanical devices were in use.

The past few years have witnessed many changes in the methods of auditors, and in the detail work that they perform. Mechanical accounting, installed in many of the larger businesses, has introduced new features, and the form of checking is materially different. Usually a /

a system of automatic internal check makes certain operations unnecessary. There is a natural and proper tendency to reduce the amount of detailed checking, and to concentrate more on matters of principle and a verification of final figures. In some very large undertakings the detailed checking by the professional auditor may be negligible. On the other hand, the smaller companies and firms which form so large a part of the average accountant's audit practice are unable to adopt systems of accounting and control that may render detailed audit work unnecessary, and, both for his own purposes and because the client desires it, the auditor must in these cases continue to perform his work in the manner which has been practised for decades past.

fields
r research.

Mechanisation opens up new fields for research.

> "The final accounts of a merchant are too often looked on by the accountant as a reflection of the books, whereas they should be a properly construed representation of the facts."
>
> "The Accountant", 5th December 1936.

The facility with which an effective system of mechanisation can produce up-to-date statistics without any considerable additional cost has undoubtedly opened up new fields of research and analysis on the statistical side of business, and has facilitated the building up of efficient organisations in many spheres.

No form of Balance Sheet has yet been designed which reveals /

reveals the potentialities of improvement in operating efficiency. It is to the prompt statistical analysis that we must turn for help in this direction.

A writer, referring to the discussions of the British Association on the Costs of Distribution ("The Accountant", 2nd September 1937) recently deplored the absence of statistics in this branch of economic investigation, particularly with reference to the avoidable wastefulness through the excessive number of retail establishments, the cost of which must ultimately be borne by the consumer. The problem whether the present system of retail distribution is organised to ensure that the cost of services fall equitably on those persons whose demands necessitate the provision of the services was also considered on these terms:-

> "If all the other costs of small retail distribution be taken into account, the prospective total of economically wasteful leakage becomes truly disquieting".
>
> "The whole matter throws into high relief the present state of darkness and uncertainty which hinders the practicability of intelligent economic planning.
>
> "A satisfactory solution can be found only in the light of much fuller knowledge, and this can only be obtained from the facts - all the facts if possible. Judgment should be suspended until these have been obtained, analysed and related to other relevant facts."

Sir /

Sir Josiah Stamp recently wrote -

"Especially in England we do not anticipate. Problems with us are usually called academic until we are going down for the third time."

Reference may be made to directions in which research may prove profitable. Lord Nuffield in his recent letter to the Vice Chancellor of Oxford University, intimating a valuable endowment, writes -

"In the meeting of the demands for new knowledge in the non-scientific subjects there is an even greater lag than in scientific subjects between research and its practical application. .... Struck by this analogy, I have been wondering during the past year whether there is any way to bridge the separation between the theoretical students of contemporary civilisation and the men responsible for carrying it on: between the economist, the political theorist, the student of government and administration on the one hand, and on the other hand, the business man, the politician, the civil servant and the local government official, not to mention the ordinary everyday man and woman.

"I have, accordingly, been much impressed by what I have heard of the recent developments in the University of modern studies in which, again as an industrialist, I am most directly interested."

* * * * *

"I have long deplored the comparative scarcity of University graduates in the highest posts on the administrative and managerial sides of industry, being one of those who believe that there is no branch of knowledge however 'academic' it may seem, which is not of positive practical value."

* * * * *

"The /

> "The main object of my proposed endowment, in the light of which also the subsequent conditions shall all be read, is to encourage research, especially but not exclusively in the field of social studies, and especially by making easier the co-operation of academic and non-academic persons."

It is obvious that modern machinery, in facilitating the production of facts will greatly enhance the practical value of such an endowment.

ropriate mbinations operations.

An important effect of the application of machinery to office work is the appropriate grouping of (not necessarily consecutive) operations in order that repetition of essential information may be automatic. One example may be given of the need for a careful study of office records if separate repetition of the same facts is to be reduced to the minimum. Suppose an order for certain goods from stock is received from a customer. This will generally involve the repetition of Order Number, name and address of customer, description of goods and quantity, delivery date and method of delivery, on a variety of documents such as -

Departmental Order
Advice Note
Invoice
Account
Personal Ledger Account
Label
Carrier's Consignment Note.

It is true that sheer necessity for labour saving has stimulated /

stimulated short references to goods, but by the use of modern machinery it is possible to combine the preparation of several of these essential documents while, at the same time, providing analytical accumulations for the purposes of the statistical requirements of the business. Further, these combined operations can be done more efficiently by suitable machinery than it was formerly possible to do any single one of them. The best combinations must necessarily vary according to the circumstances, but when it is realised that one checking will cover several stages of office records, the savings are considerable. Where mechanical proof of accuracy is also provided, this single checking may be restricted to a minimum.

Even where the most modern machinery cannot economically be employed, there are many firms who, while recognising the disadvantages of pen book-keeping, make use of a system of book-keeping by typewriter. All the mechanical equipment that is necessary is a dual feed typewriter and possibly a small adding machine. A considerable amount of duplication of routine is avoidable by this system, as it reduces eight operations to these four: (1) The invoice and detailed day book; (2) The statement, ledger account and proof sheet; (3) The receipt, cash book and bank paying-in slip; (4) Crediting the /

the ledger account with cash paid. It is a simple matter for statements to be compiled daily, item by item, and at the end of the month they are ready for dispatch to customers without great hurry. The invoice copies, filed in a suitable loose-leaf binder, form the day-book and obviate wearying copying. On the receipt of cash, a receipt, posting copy, cash book and bank paying-in slip are compiled in one operation. Purchase ledgers are similarly compiled, and the firm's cheques can be typed.

Hitherto, the subdivision and grouping of activities has been determined, ~~by~~ very largely, by convention, by reference to personal capacities of the individuals available. Technical principles should take priority over all traditional, personal or political considerations. The subdivision of activity according to mechanical capacities becomes a matter of great importance for the economical and effective application of office machinery.

ects on nancing.

The promptitude with which accounts can be continuously issued and followed up under a well managed mechanical system may reduce considerably the amount of borrowing involved in a large undertaking. A reduction in the burden of bad debts normally following the prompt rendering of accounts is a matter of great importance where margins of profit are relatively small. Expenditure also can be closely /

closely watched and rapidly changing overhead costs more truly allocated to the turnover which should bear them.

lculations educed to minimum.

Where intricate or repeated calculations feature largely in office records, the application of appropriate machinery to the work confers great advantage as so much of this, e.g. addition, subtraction, multiplication and division can be accomplished automatically, or nearly so, in a very short space of time. There is the indirect advantage that the very concentration of calculating work at the machine often results in many identical transactions being brought into juxta position, so that one extension serves to solve several transactions. The reduction of mental effort, and, mayhap, the avoidance of overtime is a direct gain to employer and employed.

rrelation f cost and inancial ecords.

As Mr J. D. Imrie pointed out ("The 'End' of Local Government in relation to the Means", "Public Administration", Vol. XIII, No. 4) costing has acquired a new significance through the increased size in the units of administration, and the minimisation of the significance of many special local conditions which inevitably disturbed the value of comparative statistics and through the tendency towards standardisation of service. Mechanisation is making a very valuable contribution towards the reliability of /

of costs by making it a relatively simple matter to prove the accuracy of costs in relation to the financial results of the business.

ak loads.

While the aim of all office systems should be to level out peak loads, in order that a minimum staff may be continuously employed throughout the working periods, the entire elimination of variations in loads may be extremely difficult. Any system which enables such variations to be easily coped with is of advantage. It may fairly be claimed that by virtue of the speed at which recording can be done mechanically, modern equipment has much to commend it. By the simple device of relieving machine operators, at least during a rush period, of all non-mechanical operations, such as picking out of folios, sorting, etc., or by utilising machinery on "shifts", a very great increase in output can be obtained. To those who master the technique of speeding up operations, the possibilities and opportunities for overcoming apparent overloads are rarely lacking. The margins of capacity which are so often available in office machinery are also of great value, in enabling any relatively permanent increased volume of work to be overtaken without augmenting the staff until such time as additional machinery becomes inevitable /

inevitable. Although office machinery is not so expensive to keep up as office personnel, it is undoubtedly true to say that more consideration is generally given to the continuous employment of machines than of personnel. The reason is not far to seek. An idle machine is usually obvious to the casual observer, but staff busily engaged doing next to nothing are not so easily detected.

tinuity action.

The introduction of relatively expensive machinery tends to have the effect that there will be some measure of continuity of action for some time. This stabilising effect ensures that personal predilection for one method or another is unlikely to destroy the fundamental uniformity in the method of preparation of statements, statistics, etc. In this way the value of the facts collected in relation to a business are enhanced. On the other hand, there is the danger that progress in method and approach may be retarded by the very presence of mechanical means to undertake routine work. Insidious changes are apt to take place in the nature of work during the working life of machinery, so that the initial advantages arising from its application may be considerably reduced in course of time. It is by no means uncommon to find that full use of every item of plant is not being made, or that a combination of processes not /

not originally practicable can be made under altered circumstances. An attitude of wakefulness and a periodical test out of actual practice as contrasted with intended procedure is the only safeguard against that dulling sense of satisfaction arising from a smooth running mechanical system. Just as it is rarely safe to accept mechanisation without evidence of its advantages, so it is unsafe to continue its use indefinitely without a re-examination of the circumstances.

elopment team irit.

"We have many members in one body and all members have not the same office."
(Romans XII, 4.)

Reference has already been made to the principle of division of labour and to the appropriate combination of operations inherent in office mechanisation. There is, however, another aspect which is also significant. The office as controlling centre of a business is essentially a unit, however complex that unit may be. Where extensive mechanisation has been applied there must be developed a high degree of co-ordination. The essence of all division of labour is the subdivision of a complex task for its more effective accomplishment. Individual self-sufficiency, which from very earliest times was always something of a myth, must, of necessity, recede before the advance of this technique. Unless interdependence of units /

units is accompanied by the development of a proper team spirit, only results harmful to the whole organisation can emerge. The meshing in of operations and of functions leading up to the ultimate control of the business is the problem of co-ordination. In the sphere of office mechanisation it is a growing problem of very great significance. If a spirit of co-operation characterises the will of the people engaged in the business, difficulties inseparable from mechanisation will readily be overcome. The fact that such a system cannot work, far less work well, without this high degree of ordered effort tends to a greater attention being given to improved technique of office organisation. The relatively few failures in office mechanisation, despite the extent to which it has been applied and the progress maintained by such firms adopting it supports this view.

onomies. The careful management of resources so as to make them go as far as possible is the essence of economy. The economic justification for the installation of office machinery rests, therefore, in the provision of essential information at less cost than hitherto, at an earlier date or time if possible, and with greater regularity and certainty and less inconvenience. If this is conjoined with the avoidance of the necessity for extending office accommodation and augmenting staff in consequence of increased volume of work, so much the better. Centralisation /

Centralisation (and consequent greater privacy for such documents as merit it) of office work has, as a general rule, much to commend it as a corollary to mechanisation, but its true cost should be known. The preparation of a cost account or a cost estimate carefully compiled and embracing pluses and minuses at head office and branches is as desirable in reference to an installation of office machinery as it is to manufacture. It would be interesting to know how often this is done.

Despite the high capital cost of modern office machinery it is undoubtedly true that where efficient arrangements are made for its application to routine work in the office and the volume of work justifies the installation of machinery appropriate for the work to be performed, considerable economies can be made. These economies emerge in many directions and are reflected in different degrees according to the circumstances. It will serve if an indication is given of the more important.

(a) Labour costs.

Labour costs are rising. With falling population, this tendency is likely to continue and labour saving devices in the office will more and more be required to meet this increased burden of doing business. Hours of work are shortening. There is little indication of these being longer in the future. Yet record keeping for national and co-operative purposes is piling up. Income Tax/

Tax, Superannuation, Health and Unemployment Insurance, Marketing Schemes, hire purchase methods, Trade Associations, Factory and Road Traffic Acts, all impose their quota of recording. Municipal work, from a simple beginning, now touches many spheres of social life from the cradle - nay even before it (pre-natal clinics) - to the grave and beyond it (maintenance of burial grounds). Amalgamations and the growth in the size of the business unit brings in its train departmentalism and some measure of inevitable duplication of records. The uses of departmental accounts may be to find out whether each department is sufficiently profitable to justify its continuance, or to find out whether the heads of such departments are avoiding unnecessary expenses. The determination of suitable selling firms for individual articles may justify detailed recording where aggregate accounts might otherwise suffice. Whatever the reason, such clerical work can only be undertaken at a price which must, in the long run, be met in the selling price. The prospective diminution of the numbers of the population in the wage-earning groups means that growing labour costs will fall to be borne by relatively fewer persons, while the growth in the number of dependents in the old-age groups will continue to rise for many years to come, thereby increasing the social burdens. The urge to economise /

economise labour and reduce this element of cost, therefore, is a matter of the utmost significance if the present standard of life is to be maintained.

Not only in the performance of a given task can machines help to reduce these costs, but in the simultaneous performance of subsidiary tasks.

Two further labour points emerge. The economic conception of a quantity of labour embraces the cost of training. With a reasonably good selection of operators, the requisite skill is much more readily obtained from machine operators than by pen and ink methods. Further, the capacity of machines for coping with peak loads of work considerably reduces the need for still more costly overtime with all its concomitant disadvantages of diminishing accuracy and output. (Appendix 32 gives two examples of economies effected through office mechanisation).

) Premises. It follows that if the growth of clerical staffs can be checked, the extent of the premises devoted to "unproductive" work involving a saving in rent, lighting, heating, cleaning, etc., overhead expenses will be materially lessened, while a greater volume of business may obviate the need for capital outlay in office extensions. It may, however, be that office plant may itself require added space or even isolation, and structural alterations must be considered in the light of advantages to be obtained through /

through installation.

) Accuracy. The greater accuracy of machine operation has already been emphasised. In business, errors are always costly. They may alienate a customer, involve considerable expense in tracing, and further costs in rectifying them. While the exercise of human faculties may become highly automatic there are, as we have seen, many mechanical features which, from the very start, are wholly automatic all the time and consequently mental concentration can be restricted to the conscious performance of the work requiring thought and care. Where labour turnover is considerable, the narrowing of the field for the human element is of significance. Much has been done statistically in bringing to notice the £.s.d. of accidents and the accident rate from an industrial point of view, but little has been done in bringing into the limelight the costs of clerical errors. The behaviouristic aspect of mechanisation has already been referred to in the tendency towards a general conciseness and precision in regard to time and method for every operation which almost naturally comes to be regarded as a part of the system. This development of a technique in even the smallest details as a practical manifestation of a system has a significance which is invaluable, if for one reason only, that the presence of a standard of performance inevitably stimulates the critical faculty which in turn leads to progress.

It /

Service. It has for long been an axiom that production is not complete till the product is in the hands of the consumer. This conception requires some modification to-day, as service to the consumer after sale has grown to very considerable proportions. From the point of view of the office, there is considerable economy in having a mechanised system capable, with small additional cost, of maintaining that connection by way of periodical communication. But there is the further consideration that prompt rendering of accurate accounts, expeditious dispatch of answers to enquiries, etc., have a business value which creates an atmosphere conducive to quick turnover.

) Information. Information where it ought to be and privacy where that is appropriate each have a definite place in the economics of business. Office mechanisation helps materially in both these connections. The automatic balancing of ledgers and the rapid preparation of control figures for the management is a considerable help in deciding the wisest policy. The mechanically posted stock ledger helps to reduce the amount of capital tied up in stocks. The prompt rendering of accounts reduces the amount necessary to finance an undertaking. The daily proving of income safeguards the revenues of the business. On the other hand, codification, so essential to the efficient /

efficient mechanisation of certain types of records, and subdivision of function necessary where specialised machinery is in use, gives a greater measure of privacy to business transactions as far as the routine office workers are concerned.

nclusion. There are many more consequences arising from office mechanisation. Some of them - not the less important on this account - are of such an indirect nature that it would be difficult to prove the relationship of cause and effect. Others are of such a particularised nature that they cannot find any place in a general treatise.

But the fact that "the oilcan is replacing the blue pencil in the accountancy business" must, of necessity, bring about changes of fundamental significance, not all of which are to the advantage of business.

The British Association for the Advancement of Science recently discussed the various disguises which inefficient men and women assume to conceal unfitness for their work and concluded that -

> "A staff manager not ideally fitted for his job would sometimes tend to find compensation in the development of a keen enthusiasm for elaborate systems of record-keeping - systems which at least enabled him to manage his people on paper."

National and instructional competition at the beginning of the 20th century led to the stimulation of efforts to improve /

improve factory management in an endeavour to reduce costs of production and retain profit margins. As a consequence, production has had its mede of attention. Time and fatigue studies, wage incentive methods, production planning, and standard costs, are but a few of the aspects of production which have been the subject of scientific study.

The accountant, however, is only beginning to realise that he must be prepared to go back to the factory, nay to the various items of plant, to find the proper basis for his accounts, and if he is to do so under modern conditions of large scale production, this involves him in a mass of detailed analysis which can only economically be achieved by the aid of tabulating, accounting and calculating machinery.

In a recent speech, Sir Francis Joseph, C.B.E., D.L., said -

> "There is no use bringing your production up to date unless you perfect your office organisation. Complete information means the ability to check and prove each step in the execution of an order. We don't post less letters because we are constantly speaking to our customers over the telephone. We write better letters by the typewriter than we did by longhand. It was too much trouble to rewrite the letter and correct the mistakes.
>
> "The world demands better service year by year. The firm which keeps abreast of the times in office organisation and equipment is generally first with a new range of goods to catch the buyer's eye."

Modern /

Modern office machinery does much more than furnish an expeditious means of overtaking routine clerical work with accuracy. This is only one of its recommendations

A well-known auditor, Mr S. W. Rowland, LL.B., F.C.A., is reported to have said recently -

> "I think a great part of the future of the accounting machine lies in its power to release the Administrator's mind from the tyranny of detail, leaving him free to fulfil the functions which are really his. And a similar remark applies to the Auditor. My confidence in a scheme of machine book-keeping is always based upon the reflection that if the thing works at all, it argues the existence of definite system in the collection and bringing forward of original data. That is to say, the old-fashioned hand and brain could easily cope with irregularities in this respect and so hide them. Not so the machine. A piece of grit in the wheels becomes immediately apparent and the man who is working the system finds that it actually pays him to be vigilant in abolishing the sources of difficulty. The stream must flow smoothly or burst its banks. Circumstances are, of course, infinitely variable, and only human vigilance can ensure that machines are rightly instructed."

CHAPTER VIII.

A Developing Science and a Science of Development.

> "In recent years, economists have become increasingly interested in the activities of business men as reflected in accounting records, and accountants have looked up from their work to take notice of the economist and his abstractions."
>
> Canadian Journal of Economics and Political Science.

ffice mechanisation is a study in realistic economics.

"The economist is trained to set imaginary forces at "work and, by logical processes, to deduce what their "resultant is likely to be. The accountant, on the other "hand, is trained to watch actual forces at work and to "measure what their resultant has been as a matter of "ascertainable fact. Thinkers belonging to these two "schools can help one another, but they must realise that "they do belong to different schools."

("The Accountant's Future - "The Accountant", 12th Nov. 1938).

To those who have had experience in both schools, imagination regarding the future in contact with experience c of the actual facts of everyday business problems connected with the selection and application of office machinery to a wide diversity of industries will, as a rule, produce suggestions not too far above the realities of the subject.

Indeed, during the course of these researches, it has

been /

been found necessary on several occasions to transfer many observations on future developments to that of achievement and successful application. It will ever be thus, where progress is so marked as it has been in the development of office machinery. Notwithstanding this apparent futility of keeping abreast of progress, it is desirable at times to pause and attempt to clarify thoughts, to get "to know "the idea" underlying progress itself. In the realm of office work this is as necessary as it has been proved to be in the factory where the industrial psychologist has already had glorious opportunities. "No one ever "heard of factory or workshop without an office - even if "it is only a glass panelled partition in the corner. "The simple truth is that, without an office, no pro- "ductive industry could exist". ("The Accountant", 5th November 1938). When to this consideration is added the observation that there are many thousands of offices where no factory or workshop is involved, and through whose windows no psychologist has ever been invited to look, the scope for a modicum of stocktaking is so considerable that no apology is needed for this survey.

Under dynamic conditions.

Although the slender roots of office mechanisation can be /

be traced in the previous century, its sturdy growth is essentially a 20th century marvel, profoundly affecting, not only the development, but the very structure of economic activity. Sturdy growth is but the outcome of the process of selection or survival of the fittest and favourable conditions, or, in the language of the economist, of marginal utility under circumstances of elasticity in demand and supply.

In the days of the one man business, it might be said that book-keeping, costing and control, were synonymous, at least in function. With the growth in the size of the business unit, however, an intellectual revolution has gradually taken place. Each of these functions has become specialised and developed into something of a stranger to the other, linked only by ties of common purpose. And the greatest of these is control. Control may be said to be not the antithesis of individualism, but the correlation of machinery, and so it has proved to be in actual practice.

In a recent speech (May 1937) Mr Stanley Cursitor, R.S.A., is reported to have said -

"The great and good machine might demand a greater concentration of our attention for a shorter but more intense period in producing the flood of manufactured articles essential for a standardised existence, but, paradoxically, in a more intensive machine age, we might have /

> have more time to exercise craft and make with our hands things worth having. The machine might yet be the saviour of the arts."

Unity of control.

Mechanisation facilitates that oneness of control so essential to quick decisions and prompt action. Definition of duties, of operations, of organisation, all tend towards definiteness of individual responsibility, and control becomes a matter of watching certain key positions. Standardisation of cost and rate of output, rapid elimination of delays in production, the automatic discovery of inefficient units, and the reduced necessity for supervision, over all the field of production, enables a greater degree of attention to be given to the more essential matters of policy. Further, such control is continuous, regular, and sustained, through the very facility with which the necessary figures can be produced.

Creates a demand for new forms of organising ability.

The growth of office mechanisation has brought to light the need for a new form of administrative ability, namely, an analytical understanding of clerical work and machine operations; and a power to contrast, compare and assess the respective merits of different mechanical systems. As stated earlier, it must always be the function of the management to decide, but a flexibility of mind and outlook which can visualise auxiliary uses for a plant primarily %

primarily installed for a specific purpose is an attribute to be looked for in the administrator who should always be prepared to sacrifice custom for efficiency. In his make-up there must be a capacity to winnow the essential needs of a business from the chaff which is so attractively strewn by the machine salesman, and a highly developed audit sense to look for methods of proof, not only of individual transactions, but also of ~~runs~~ totals, and at pre-determined points. He who would aspire to exercise control must keep a finger on the pulse of the whole mechanised system and have sufficient experience to take over active management if anything unforeseen emerges, and the tact and disposition to overcome prejudice and even hostility to the mechanical accomplishment. The capacity to visualise a mechanical system in its completed state from the early beginnings of a scheme must be in his soul.

echanisation egets echanisation.

Almost invariably the success attending partial mechanisation leads to a further extension as opportunity offers. Addressing machinery, for example, may be installed by a sales department for the primary purpose of cirdularising customers, but it is often found that extension of its use in the wages department is practicable. Another result of even more significance emerges - that of creating a new demand for the mechanisation of fresh operations /

operations hitherto unprovided for as being beyond the scope of existing machinery. Thus, supply creates demand as surely as former demands have given birth to supplies. "The thin edge of the present is constantly cutting its "way into the future" (Edwin Haskell Schill).

achines of the future,

Having surveyed this wide field of office mechanisation it might be expected that the future can hold little prospect of very material advances. This would be contrary to the experience of the past. New types of machinery have f followed each other so rapidly that it has been quite impossible to keep pace with improvements even during the period of preparation of this survey. Each yearly exhibition of the Office Appliance Association popularises for the first time something remarkable, and there is every reason to believe that, provided there is the demand for additional labour serving and labour saving appliances, the ingenuity of man will not be found wanting to supply it at a price. To venture too far into the future is to become a visionary, and a prophet. Too great a rate of progress in machinery development might result in the development of administrative technique being outstripped, and this would be something of a tragedy, but a degree of familiarity with trends in development is essential to a study of the question. He who would envisage the future has much /

much to conjure up. A few indications may, however, be given of possible developments in the near future, and this is perhaps as far as forecasting is justified in a realistic study of this kind.

The following suggestions are, therefore, made in the belief that their introduction in the near future is in keeping with the present development in administrative technique:-

(a) A combination of cash register and automatic cashier. At the present time, although a cash register makes a complete record and allocation of all payments, the cashier has still to make the calculations of deducting the charge from the money tendered, and to make up the change by hand. This subtraction and delivery of appropriate change might well be done by one composite machine.

(b) Time-clock to punch cards. - In view of the potentialities of the punched card as a medium for compiling the pay roll automatically, it appears a relatively simple matter that works time-clocks of the future should punch the appropriate holes in cards or roll instead of merely stamping the time thereon, for subsequent translation into punched holes. The card might then be made the direct medium for (1) calculation of /

of wages, (b) preparation of pay-roll, (c) making up the cash to be paid, (d) preparation of any office records for income tax, superannuation, etc. The furthest we have got at present is the dual purpose card. On the one side it is the orthodox clock card: on the other it is laid out for subsequent punching as an ordinary punched card for extension listing.

(c) A postal franker which will, in addition to performing its present functions, issue a card shewing the numbers of various denominations used each run, for the use of the Post Office, and which will bundle letters so franked (say in fifties) ready for post.

(d) An automatic or pedal operated page or document turner adaptable to the various needs of machine operators in order to conserve machine time.

(e) Various types of machinery adapted to left-handed operators.

(f) A pay envelope sealing machine which will not be discomfitted by the weight of silver in the envelopes. Several types of letter sealing machines have been tried, but the weight of coins in pay envelopes pulls the flaps out of the sealing rollers.

(g) /

(g) A machine for preparing and protecting cheques and accumulating the amounts at one operation onthe lines of the existing "Protectograph" which puts in complete words at each operation and gives crossings automatically with repeat keys for runs at the same amount. It is at present possible to prepare, protect and accumulate cheques under normal typewriting conditions by the combined use of pin point typewriter and totalisers, but this involves typing each word by letters.

(h) A typewriter which will type complete words even to a limited range of words, e.g. "Edinburgh", date, "Dear Sir", "and", "the", "of". An attachment which will tell the typist when she is nearing the bottom of her sheet. An injector and ejector for rapidly inserting and extracting forms. This arrangement is already in use on book-keeping machines and on some typewriters. A simpler and cleaner method for changing and removing ribbons.

(i) A machine for rapidly sorting irregular documents. - on this aspect of office routine the machine has not come to our assistance to any great extent Except in relation to the punched card (see Chapter V) the sorting machine does not except in certain large post office installations.

(j) /

(j) An automatic cashier for handling bank and treasury notes, which will produce a proof roll, so that any mistake in making up pays can be detected from a read over of proof roll without checking over the money. Any subsequent dispute regarding wages can then be settled by reference to the proof roll.

(k) An automatic minute taker for meetings.

(l) A dictating attachment to telephone, so that a business executive, not arriving at the office can still dictate letters to a recording machine for subsequent typing.

(m) An addressing plate with space for one known variable, e.g., "age" which increases each year, and an automatic machine for making such uniform alterations by running the plates through this correcting machine.

(n) An automatic stores delivery machine for smaller articles on the lines of the automatic vending machines and operated by key representing workman or job number, and which will, at the same time, punch a card for subsequent ledger posting, costing and statistical work.

In the facilitative aspects of mechanisation, there are innumerable improvements yet to be made, but many of these must be considered in the light of particular circumstances /

circumstances. Such improvements are of no less significance from the point of view of operating efficiency. There is undoubtedly room for improvement in the facility for changing the set up of specialised machinery, for the alternation of hands in the operation of keyboards, especially when mechanical handling of documents of original entry has become possible ((d) supra).

As each new invention is developed and marketed, administrators have from time to time studied the possibilities of combining the new invention with some other equipment or system or have studied the application of some new piece of equipment to deal with some new problem based on analogy of function. Accordingly, there is a constant interaction of suggestions for the improvement in office machinery and in its uses by users and suppliers. Just as the earliest railway coaches were planned on the lines of the stage coach until it was found that vehicles suited for one method of transportation might not be the best for another, so evolution viewed over a space of time becomes revolution. The keyboard of the earliest type-writer has tended to perpetuate the work of the hands while the feet are for the most part idle. It may well be that in the future, greater use will yet be made of pedal operation, e.g. for carriage return, release of documents /

documents, etc., with consequent improvement of operating efficiency.

But the greatest immediate hope ~~prospect~~ for the mechanical advancement of machinery itself would appear to lie ~~be~~ in the further amalgamation of the various manufacturing firms, whereby the best features of each machine might be embodied in models of more general utility. Specialisation in manufacture has proceeded, so far, along well defined lines from more or less common origins, protected by various patent rights. With the advance of science, the future may see even more striking progress than has been witnessed in the past. The direct conversion of the spoken word into the typed letter, the automatic translation of office records into administrative action, the decimalisation of international standards, suggest themselves. Needless to say, finality is never reached. We already have a numer-alpha producer providing printing and figures from punched cards. May we not see this process reversed some day and have the printed matter converted into punched cards by photo electric principle, or by intercepting rays of light? Then truly the punched card art would be universal, but the problem of efficiency in administration, if not in operation, will be for ever with us. For the present, we are mainly interested in establishing the economic application of such machinery as is available to us. Yet speculation upon the possibilities /

possibilities of the future is entertained with the specific purpose of developing in the minds of a machine minded world the idea that if the makers can improve their machines, and consequently the technique of office organisation, then there are some offices just that little ahead of present attainments.

Some time after this chapter had been prepared, there appeared in "The Accountant" (10th September 1938) a contributed article giving a glimpse of the office of twenty years hence, in which the following features are emphasised:-

(a) With the shortening of production hours, there will be no difference in the working hours of shops and administrative staffs.

(b) Overtime will be eliminated, but in the offices there will be two shifts working with machines so as to utilise these costly installations to the fullest capacity.

(c) The issue and receipt of materials will be recorded immediately the transaction takes place, and balances continuously available through mechanical or electrical transmission to the office.

(d) Correspondence will be fed into a machine, opened and delivered to a table, while the covers are automatically fed to a scrap bin.

(e) Registration of correspondence will be done mechanically by dictating machine or automatic typewriter.

(f) Copying will be done by photographic or rotary copier and suitably endorsed for action.

(g) /

(g) A return service of containers to convey all papers to every department will have replaced present messenger services.

(h) Television throughout a factory will enable drawings to be discussed wherever situated.

(i) Electrically operated time-keepers will record and calculate all time, and produce a punched card for the electric wage compiling machine.

(j) Costing of time will be automatically done on punched cards which will balance daily with the time records.

(k) Written requisitions for materials will have been replaced by electrically produced cards for subsequent sorting under stock item and job head, balance of stock and expenditures on jobs being quite automatic products of the primary operation.

So on throughout the office, sales, progress records, personal accounts, transfers, statistics, will emanate direct from the primary records and work will always be "up to the minute."

How far such a forecast can be regarded as reliable is, of course, doubtful, but it at least indicates practical lines along which improvements may be expected serves but to and/confirm ~~quite~~ a few of the suggestions already made.

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ecent times.

The growth of public utility services as we know them to-day may be said to be a modern development. The awakening of the social conscience following on the evils arising from the Industrial Revolution, expressed in the provision of water, gas, electricity and transport, on a basis /

basis, partly commercial and partly social, has served but to emphasise the inherent advantages of monopoly. The extent to which routine operations predominate in the provision of these services has created conditions favourable to effective mechanisation of the considerable office work connected with them.

Another reason for the rapid development of office machinery in recent times is the improved publicity and high quality of sound salesmanship which is devoted to it. High class exhibitions with experts in attendance who are at the disposal of interested firms have done a great deal to incite questionings as to best methods. The eagerness of intelligent salesmen to break new ground is evident to all who come into contact with these business efficiency organisations. This is something more than mere advertisement, which can but bring the merits of a product to the knowledge of the prospective purchaser. It is an enthusiasm which is infectious. The willing acceptance of responsibility to see to the successful operation of a scheme of mechanisation is the surest passport for the introduction of installations.

The following quotation of advice given to certain salesmen of an organisation is typical:-

> "You who are salesmen should realise that you can be of far more value to your prospects by selling "system" rather than "machine". Don't just sell a machine; sell a system built /

> built round the machine, which will give a better organisation, and prove the machine a better unit in that organisation. You will make a much better friend that way.
>
> "Every executive will be far more willing to listen to you if he knows that you are out to help him make his office better, not just to get him to sign a piece of paper. If you can show him a better way to do his work he will sign much more readily, and what is more important, he will think of you when needing additional equipment in your line. I know some equipment salesmen who are consulted by users about all office equipment problems, because they have sold system, not machines."

d has its ffect on he social ciences

The enclosure movement has usually been associated with agriculture, but it is generally admitted that the progress of the social sciences has been marked by the partitioning of the general field of knowledge into separate enclosures with certain debatable margins. It is not inappropriate that a look into the neighbouring park should be made from time to time. Office organisation is now a scientific subject, but it draws its information from many sides - mechanical engineering, psychology, economics, accountancy and many other subjects. The mutual interest of accountants and economists is all to the good even though the approach to problems may be different. There is nothing mechanical about the function of accountancy: mechanical accounting has reference only to the building up of the accounting and statistical data by /

by means of which the real function of accountancy or of administration is exercised. There is little mechanical about economics: it is essentially a science of circumstance which is subject to change.

The office organiser and economist are working under conditions which have much in common. Their aims are identical, to indicate and ensure the least wasteful method - the end of efficient administration.

he urge is an economic one.

The economic application of machinery to office work is but a means to this end. To confuse the means with the end is not only folly - it is fatal to the success of office organisation. -

"In the dim dawn of Egypt's golden day
An unremembered genius shaped the beam
And poised the trembling scales, and did not deem
His new-made balance other than a way
To serve an end."

W.A.B. "Weighing throughout the Ages".
W. & T. Avery.

Machinery is no complete substitute for the human element. The eyes/and brains of man must still continue to examine results, interpret them, and apply measures of improvement or remedy. For these specific functions, mechanisation can leave the human brain relatively free, but if the best results are to be secured from its adoption, the new principle must be embraced with enthusiasm begotten of confidence, and in a spirit of co-operation. Reluctance to /

to depart from proved traditional methods is not necessarily a bad thing in business - far from it - but it may not be quite honest to refrain from taking advantage of modern developments - ~~XXXXXXXXXX~~, ~~XXXXXXXXXXX~~. The master craftsman has had his day. Directional responsibility for the ramifications of a large undertaking to;day demands a new approach, new tools which will afford close contact with the business for seeing the wood without the trees unduly obtruding themselves.

A sound and logical means for meeting the accounting and statistical requirements of to-day and of to-morrow is but the counterpart of a business unit which can only be controlled by suitable presentation of a few cross sections.

There is a saying attributed to Henry Ford that if a device effects a saving of just 10 per cent., the failure to adopt it amounts to the self imposition of a 10 per cent. tax. As has been amply indicated in economic literature the first natural reaction to a tax is to avoid it (legitimately). It would appear, therefore, that the adoption of economic office mechanisation is on the lines of a natural evolution of economic progress. The necessity of attaining efficiency in office management by means of a conscious and organised study of all machine developments and all developments in office technique is absolutely vital /

vital. In the same way that the production engineer unhesitatingly makes full use of every improvement in precision machinery so must the accountant and office executive constantly examine the potentialities of all available mechanical aids in order that he may decide which will yield the greatest efficiency.

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orcing
he issue.

It would seem that the drift of labour away from farming is to-day playing a part in the mechanisation of agriculture. Sudden changes in farm organisation have always been looked at askance. "Good husbandry" is a noble phrase which sums up the farmer's pride in the adherence to the principles of his age-old craft, but the gradual trek of the plodding ploughman to the town has compelled the farmer to rely more and more on machinery, with the alternative of giving up the growing of crops which require most labour. There are those who deplore the passing of that picturesque figure from the rural scene. But there are other and greater changes taking place in society, in the falling off of the birth rate and in the extension of the school age, which are depriving trade and industry of that superfluity of young clerical workers at a time when the framers of commercial policy are beginning to display a healthy dislike of working in the dark. The inevitable result must be more and still more office machinery in order to conserve the resources of society.

If /

If the progress of science strains the social fabric what we need is more science, not less.

and education is making extended use practicable

The future development of office mechanisation will also receive an impetus from the educational urge to escape from the monotony of routine office work which can more effectively be performed by modern machinery. The rising generation, through the use of various mechanical aids in education itself, are daily becoming more acquainted with machinery, and, in many cases, are actually being trained in its effective use. Mr F. W. Michie, Education Inspector for the Northern Division of Scotland, recently observed:-

> "Conservative by nature and zealous in upholding sound and well-tried methods of instruction, the average teacher in this division has never rushed to adopt any new appliance which promised a royal road to learning for himself and his pupils ... but it can be stated that there is a gradual yearly increase."

The incentives to the use of machinery are many.

The incentives to the use of machinery are many, while the reluctance to take advantage of many labour-saving devices is no less securely founded. Dr. Johnson once remarked to Boswell that "so many objections can be "made against doing anything that we should do nothing if "it were not for the necessity of doing something". That necessity may arise from the need for the elimination of wasteful competition or to prevent its growth, or from the need /

need for the economic employment of assets, or from the urge to widen the marketing facilities, or merely for the purpose of strengthening the market. It matters but little what the real cause may be, provided we capitalise rather than oppose relentless circumstances.

> "It is impossible to stop the march of invention. The smashing of machine looms a century ago in order to prevent the supersession of the hand loom worker seems to us absurd and short-sighted. Every invention which lessens labour should contribute to the happiness of the race and help to raise the standard of living in every country."

* * * * *

> "Sir Herbert Austin holds the view in regard to the effect of mechanisation and invention, that they have brought nothing but benefits to mankind. He points to the enormous improvement in living and working conditions, which has been rendered possible by machinery."

t it is rprising hat its ssibilities re not lways ealised.

As has been shewn in considering the effect of mechanisation on employment, mechanisation may on the one hand advance too rapidly for our economic system, while on the other, our economic system may advance too slowly for mechanisation. Maladjustments are all too familiar. The growth of governmental returns, many of which are designed according to the old traditional methods, and are quite unsuited to preparation by machinery, is considerable. Departmental returns, on the other hand, are wholly under the control of an up to date organisation and /

and take account of all the requirements of the mechanical system approved for the business. When, it may well be asked, will the form of such Government returns take cognisance of the movement towards office mechanisation? Two contrasting examples may be given. Under recent legislation it became necessary for local authorities (as licensing authorities) to send reminders to holders of drivers licences to renew the licence before expiry. In the case of Edinburgh this reminder is prepared by machinery at the time of issue of the new licence, and filed in a date box for subsequent insertion in a window envelope exactly eleven months later, no extra clerical work apart from insertion in the envelope being involved. The General Post Office, however, still sends out reminders for wireless licences by post card as an entirely separate operation. To give an even more recent example, the Government have designed a form of report for Air Raid Precautions work in pad form, involving the insertion of five carbon papers in the course of receiving perhaps hundreds of vital messages during the period of an air raid. The use of continuous stationery and transverse carbons on a Primus register might, in such a case, be instrumental in saving, not money, but lives.

The changes which have taken place in the basic organisation of clerical work have come about by increments /

increments, and yet so continuously, that anyone who is in a position to make a broad survey to-day and to effect a comparison with the pre-war state of affairs must express surprise at the magnitude of the reforms and economies accomplished. Mistakes have, of course, been made, indeed large numbers of office machines ordered in the enthusiasm for office mechanisation have never been fully employed.

Side by side with the introduction of office machines there has been a movement towards the general criticism of office methods. Often radical changes have been effected with office machinery as an accessory rather than as the primary improvement. Action and reaction are always at work. The facility with which office routine work can now be undertaken in mass has caused in philosophic minds the questioning as to the real utility of many of these products of machinery. The battle between the statistician and the plain man who believes only what he observes for himself will still go on, but it appears true to say that organisations built up solely on the basis of individual experience may be too individualistic for this communal age. There must be a process of sharing of experience.

In a world rapidly movingtowards a planned economy, Lord Stamp recently said:-

> "A planned world will only be kept in working order by a phenomenal development of accountancy. A half;planned world will only /

> only be kept from chaos by almost a miracle of costing and impersonal accountancy."

There is perhaps need for something more - a faith well founded in the modern inventions which Providence has made available to mankind - "Behold, I make all things "new". (Revelations 21, 5).

Appendix No. 33 gives illustrations of the old and the new accounts of the City of Edinburgh.

LIST of APPENDICES

17 /

APPENDIX 1.

The Age Distribution of the Population of Scotland during the last four Census Periods.

SCOTLAND.

		1901	1911	1921	1931
The feed for operators.	0- 4	533,033	532,745	472,373	423,346
	5- 9	492,747	513,758	477,346	455,713
	10-14	469,322	490,134	489,993	425,815
	Total	1,495,102	1,536,637	1,439,712	1,304,874
The recruiting field for operators	15-19	456,035	462,737	478,100	439,292
	20-24	433,288	419,481	428,781	421,577
	25-29	378,971	385,736	376,343	389,033
	Total	1,268,294	1,267,954	1,283,224	1,249,902
The feed for administrators.	30-34	315,211	355,540	337,935	349,495
	35-39	277,911	324,644	324,155	316,154
	40-44	245,418	275,766	308,353	292,243
	Total	838,540	955,950	970,443	957,892
The recruiting field for administrators.	45-49	208,818	241,016	289,958	280,583
	50-54	176,521	205,674	244,542	266,533
	55-59	142,762	166,265	200,569	238,021
	Total	528,101	612,955	735,069	785,137
The "aged"	60-64	125,609	129,605	161,377	191,771
	65-69	86,783	104,526	123,369	148,808
	70-74	64,139	80,460	83,510	106,185
	75 and over	65,535	72,817	85,793	98,411
	Total	342,066	387,408	454,049	545,175
Grand Total		4,472,103	4,760,904	4,882,497	4,842,980

Extract from 1931 Census Report -

Attention was also drawn to the ageing of the population.

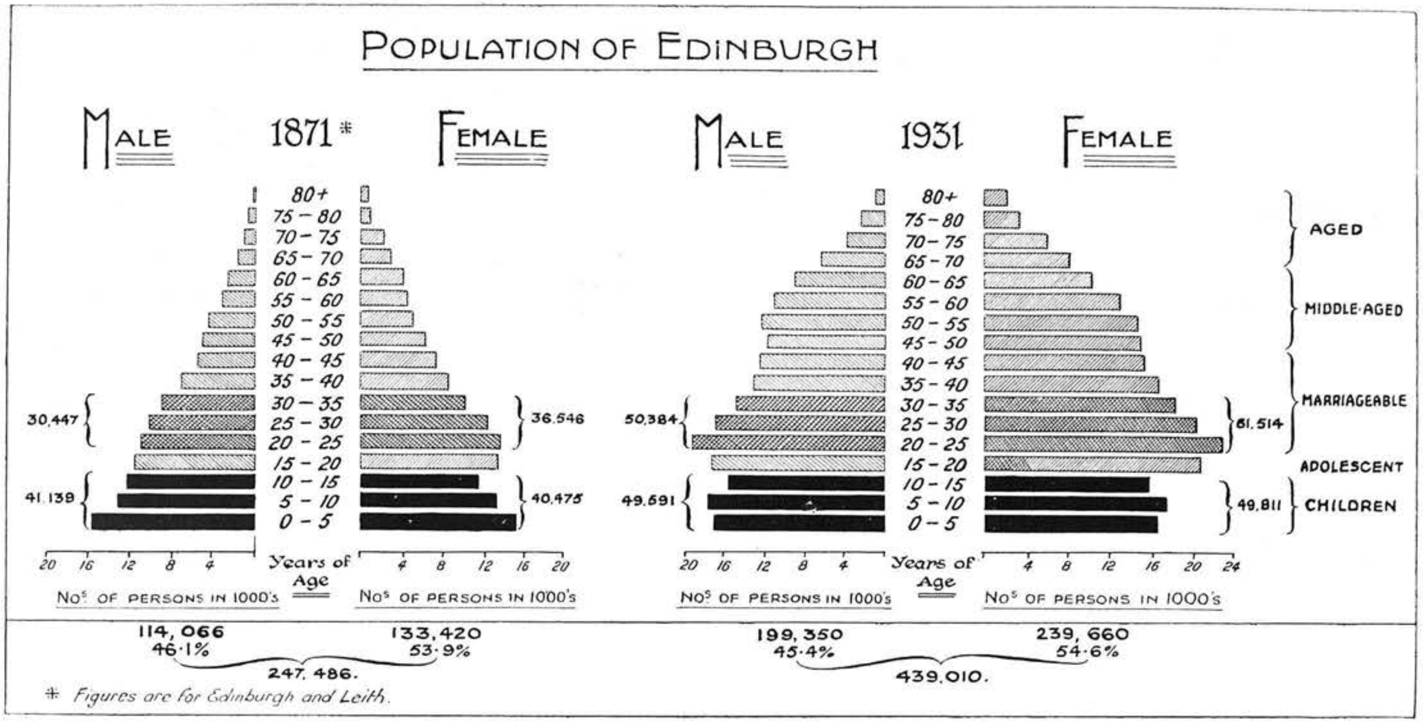
The /

The result is that while the total population has decreased by 39,517 during the intercensal period (since 1921) the number aged 14 years and over shews an actual increase of 78,731 of which 37,415 are males and 41,316 females. (see diagram)

Observation -

The smaller numbers in the youngest age groups at the 1931 census bespeaks a progressive shortage of juveniles in years to come. Even at 1931 the bulge in population has passed to age group 25-29 and over. The appended population diagram for the City of Edinburgh illustrates this movement in the centre of gravity in demographic distribution.

DIAGRAM ILLUSTRATING AGEING OF POPULATION.



APPENDIX 2.

Statement shewing the numbers and percentages of population in Scotland engaged in office occupations during the last four census periods.

	1901	1911	1921	1931
Commerce and finance	82,480	107,147	149,816	146,723
Clerical . . .	105,114	138,813	200,305	247,382
Total - Office Occupations .	187,594	245,960	350,121	394,105
Total Population .	4,472,103	4,759,445	4,882,497	4,842,980
Percentage of total population engaged in office occupations .	4.19	5.17	7.17	8.14
Occupied gainfully or otherwise .	1,982,452	2,066,967	2,179,269	2,221,375
Persons engaged in office occupations expressed as a percentage of total occupied persons . .	9.46	11.9	16.08	17.74

Notes on Census, 1931

Numbers in Occupations.

Gainfully occupied males number 1,542,253 representing 90.3 per cent. of the male population aged 14 and upwards, and females 659,057 or 34.5 per cent. of the female population at these ages. Compared with the previous census the number of males shews a decrease of 435 but that of females an increase of 23,236. The increase in the latter is most marked in Personal Services and in Commercial Occupations.

Occupations of Juveniles.

The largest numbers of male juveniles are found among metal workers, in agricultural occupations and in commercial occupations, and of female juveniles in personal service and in commercial occupations.

Principal Industries.

Compared with the previous census, large increases are found in the numbers employed in Commerce and Finance.

Functional Division of Industries.

Some notable changes have occurred in functional distribution since 1921. The numbers in Productive have decreased by 166,106; those in Commerce and Finance have increased by 47,077.

Out of every 1,000 occupied persons, 475 are in production compared with 559 in 1921; 111 are in Commerce and Finance compared with 92 in 1921.

British Association for
Commercial and Industrial
Education - Office Mechanisation
by J. F. McCartney.

APPENDIX No. 2

NOTES on CENSUS :- ENGLAND

In 1921 the Census figures disclosed that there were 627,792 men employed in the clerical profession. In 1931 there were 864,758, an increase of approximately 38%. In 1921 there were 497,887 women employed in offices, and in 1931, 657,396, an increase of approximately 32%. When it is borne in mind that during that period of ten years it is probable that the greatest advance in the introduction of machinery into offices took place, and when it is further realised that 1931 was a year of depression, I think the figures are not only a complete answer to those who say that mechanisation has resulted in increased unemployment, but show that employment has increased despite it.

I have endeavoured to obtain later figures, but, unfortunately, they are not available in the same form. I am, however, assured by officials of the Ministry of Labour that, so far as they can say, the figures for clerical employment still show an upward trend. In this connection it is interesting to study the Annual Report of the Head Masters' and Head Mistresses' Employment Committee for 1936. In the case of boys, not only was the demand in 1936 higher than in 1935, but so active was the demand that in June 1936 the register of candidates had fallen to the record low level of /

of 61, and during the first half of the year it was always difficult to meet employers' demands. The feature of the Committee's placings in 1936 was the substantial increase in the proportion of boys placed in the Banking, Finance, Stock-broking and Insurance groups. As is well known, most of the Banks and Insurance Companies are large users of mechanical aids.

In the case of girls the demand was so great that nearly 40% of the vacancies notified to the Committee remained unfilled.

Statement showing the development of three typical Office Machinery Firms during the periods specified against each.

Firm A			Firm B		Firm C		
Year	No. of Employees	Annual Sales in Units	Year	Production Factory Values £000	Year	No. of Employees	Annual Sales in Units
					1910	200	191
1924	25	145			1920	400	1,059
1930	181	283			1930	500	1,140
			1932	-			
			1933	342			
			1934	350			
1935	216	574	1935	585			
1938	303	627			1938	1,000	2,779

APPENDIX 4

Ratio of Males to Females in Clerical Staffs (as distinct from Office Occupations).

SCOTLAND.

	1901	1911	1921	1931
Males	63,572	72,229	75,786	69,272
Females	18,908	34,918	74,030	77,451
Total	82,480	107,147	149,816	146,723
Percentage of Females to total . .	22.92	32.59	49.41	52.79

Notes:

Owing to intercensal changes in occupation classifications, the figures for 1901. 1911 and 1921 have had to be constructed from the census returns in order to be comparable with the 1931 basis. The analysis (both sexes) is as follows:-

	1901	1911	1921
Commercial Clerks and Draughtsmen . .	74,516	91,108	127,453
Civil Service . .	5,413	10,552	14,576
Local Authority . .	2,551	5,487	7,739
Others			48
	82,480	107,147	149,816

1911 Census.

Male commercial clerks (included in figure of 72,229) number 40,337, constitute 2.7 per cent. of the total occupied males and is 1,826 or 4.7 per cent. more than in 1901. 19,593 of these were employed in the four cities.

Female commercial clerks (included in the figure of 34,918 number 29,067, constitute 4.9 per cent. of the total occupied females or 88.8 per cent. more than in 1901. 15,428 of these were employed in the four cities.

Extracts from "The History and Development of Typewriters", a South Kensington Science Museum publication.

APPENDIX No. 5

We are to-day so familiar with the part taken by women in commercial life that one may overlook the very important part played by the typewriter in their so-called "emancipation." It opened up a new field for female employment, and during the last fifty years has provided an occupation and living for literally millions of women, the actual figure being difficult to compute, but considered to be now well over the half-million in Great Britain alone.

* * * * *

This Handbook of the National Collection of Typewriters illustrates in considerable detail how the evolution of the modern machine has come about from the early trials and struggles of many inventors. In the early days the urge to provide writing machines for the use of blind persons was one ofi the main factors in experimental development. This desire seems to have been particularly active in the late eighteenth and early nineteenth centuries, when some twenty-three different methods of making embossed printing were in existence, of which the best known were those devised by Lucas, Frere, Moon, and Braille. The latter published his system in 1829 and developed it further in 1834. It was officially recognised in Paris in 1854.

Somewhat later than the foregoing, the advances made in the /

the electric telegraph brought about the design of machines for the rapid transcription of telegrams. The development of the typewriter proper is in effect the most modern stage in man's endeavour to break away from the limitations of the written word, though the urge to speed up the methods of recording thought and speech is no modern development. It goes back to the earliest civilisations, to the impressed clay plaques of the Akkadians and Sumerians, to seals, roller impressors, etc., and to shorthand writing which was certainly used by the ancient Greeks from at least the fourth century B.C.; whilst later we have the introduction of the "Notae Tiroianae" consisting of some 5,000 word-signs, invented by Marcus Tullius Tiro, a learned slave freed by Cicero and made his secretary. Tiro's "note" system was widely used in ancient Rome. Following the Middle Ages, during which a practice had grown up of using contracted words and abbreviations in manuscript writing and in printing, there occurred a recrudescence of inventiveness in the art of shorthand, shown by such systems as those of John Willis, whose "Art of Stenographie" ran to fourteen editions between 1602 and 1647, and the systems of Tiffin, 1750; Lyle, 1762; Holdsworth and Aldridge, 1766; Roe, 1802; Bailey, 1819; Towndrow, 1831; and De Stains, 1839, which were all phonetic systems, with the important publication of Pitman's "Stenographic Sound-Hand" in 1837, and in December, 1841 the first issue of what later became "Pitman's Journal", all being stages in the reduction of the /

the labour of handwriting.

It was not until the adoption of printing in the middle fifteenth century, after its 800-year development in the Far East, that we in Europe were able to free ourselves from some of the slavery of the pen; until then every document, every manuscript had to be written out by hand.

Typewriting is in fact an intermediate step between handwriting and typesetting and printing. Handwriting has almost disappeared in many business activities, though still retained in such occupations as engrossing legal documents and the like uses.

* * * * * *

It is interesting to note that the practical typewriting machine only celebrated its sixty-first birthday on March 1st, 1938, the date in 1873 when Messrs. E. Remington & Sons signed a contract to manufacture the "Sholes and Glidden" typewriter, the history of which is fully dealt with later. Many inventors during the preceding half-century had produced experimental machines quite as meritorious as the crude ideas which formed the early efforts of the group associated with Sholes, but the circumstance which rendered their efforts abortive was that the time was not ripe for the invention. We have seen, however, that many of the early devices were primarily intended to permit those suffering from blindness to read and write. Here speed is of ~~our~~ little account, and it was not until the /

the machine became capable of far surpassing the pen in speed that the possibilities of the device began to be appreciated. Speed was the chief reason for exchanging the penny pen for a machine usually costing over £20, legibility being a secondary though important consideration, and, until the business world realised that the use of shorthand dictation coupled with its transcription by the typewriter freed the busy man from pen drudgery, the typewriting machine remained but an interesting novelty. Even by 1873, when Sholes had completed his experimental work, the time was not quite ripe, and the Remington Company found it a hard task to interest the public; and, when the typewriter made its first serious appearance in public, at the Centennial Exposition in 1876, it attracted but little attention, whereas the Graham Bell telephone also exhibited created world-wide interest. In those early years one group after another of salesmen failed to induce a public interest. It is illuminating to find that in 1881 the Remington Company disposed of only 1,200 machines during the year. The turning point in sales came in 1882, when the well-known firm of Wyckoff, Seamans, & Benedict was formed to take over the selling agency for the whole world. This firm purchased the Remington interests in 1886. The manufacturing side was later reconstituted as the Remington Typewriter Company, in 1903, and in 1927 this was included in the organisation of Remington Rand Inc.

Extract from "The History and Development of Typewriters".

APPENDIX No.

"INTERNATIONAL" ELECTRIC TYPEWRITER, 1935.

This typewriter is operated electrically, and very high speeds may be reached with relatively little fatigue. The makers claim that in the electrically operated type the mechanical effort is only 2 oz. through $\frac{1}{8}$ in., only a fraction of that required on the average manual machine. The heavier operations, such as carriage return, shift for capitals, back-spacing, etc. require no more manual effort than the type keys. The flat keyboard also contributes to the ease of typing at high speeds. The pressure exerted on the keys makes no difference to that communicated to the working movements so that very even impressions are always obtained.

An electric motor imparts constant motion toa friction roller which in turn drives the operation mechanism of the type-bars, which comprises a double-faced friction cam held just clear of the roller on to which it is brought into contact when released by a slight pressure on a key. When one of these cams touches the roller it receives a kick due to the friction between the cam and the revolving roller. This force operates the type-bar and other movements. The cam turns through half a revolution, bringing into position a portion which is formed as a radius a little greater than that of the roller, which permits the type-bar to return to the "set" position. The manual force required is only that necessary to release a stop pin retaining the cam in the "set" position. For taking carbon copies the speed of the friction roller may be increased by adjusting an indicator at the right-hand rear portion of the machine, a higher speed increasing the force applied to the ~~machine-~~ mechanism. The indicator caters for copies up to 25 at a time, but for such a number thin paper and a specially hard platen are normally required. Speciment of the first and twenty-fifth copies so obtained are exhibited nearby. The /

The evenness of the impression permits the cutting of perfect stencils, without special skill. The carriage return mechanism automatically adjusts the line spacing, for which a control from one to three lines space is provided. The type-bar movement is so designed that clashing of adjacent bars is not met with at the highest speeds normally obtained.

HISTORY of the TYPEWRITER

A landmark in the history of typewriters for commercial use was reached in 1923, when the jubilee celebrations of the founding of the typewriter industry took place. According to "Typewriter Topics", the first patent for a machine having the semblance of a typewriter was granted in 1713 to an English engineer, whilst the first patent granted in America was in 1829. Later, both France and Italy claimed attention in this connection.

It soon became apparent to inventors that what at first had contained the germ of a writing machine could be developed and exploited for commercial purposes, but it was not until 1873 that a machine which could fairly claim to be a typewriter in the sense that we know these machines to-day made its appearance, though thirty years prior to that date a machine was invented which contained a platen and a set of keys, which were rotated and operated singly by the finger, no keyboard then having been invented.

Debut of "The Typewriter"

The machine of 1873 was invented by C. L. Sholes, and was manufactured by Remington, the progenitor of the present Remington Typewriter Co. who, in company with Densmore and Yost, also well-known names in the typewriter industry, actually manufactured /

manufactured and marketed the machine as a commercial proposition. That their initial efforts were highly successful is acknowledged on all sides. Originally known as "The Typewriter", the Remington Model No. 1, as it was afterwards named, was a blind machine, that is, it was a non-visible writer, but it contained a platen and four banks of keys.

Other important dates in connection with the development of the machine are contained in an announcement of the Remington Typewriter Co., which appeared in the jubilee number of "Typewriter Topics" for October, 1923, and are as follows:-

1873 - Introduction of the first practical typewriter, and the ancestor of the writing machine.

1878 - Shift-key fitted, allowing the writing of both capitals and small letters by the depression of one and the same key.

1896 - Automatic ribbon reverse first introduced.

1898 - Decimal tabulator first fitted.

1907 - Adding and subtracting typewriter appeared on the market.

1908 - Automatic line indenting mechanism.

1911 - Key-set decimal tabulator.

1914 - Complete typewriter-accounting machine.

1920 - Portable typewriter.

It should be noted that the whole of these inventions were first introduced on Remington typewriters.

Sources /

Sources of Inventions

From time to time inventors in many countries have turned their attention to the improvement of typewriters, and in connection with the jubilee celebrations mentioned above "Typewriter Topics" issued an illuminating history and encyclopaedia of the typewriter industry. From this it is gathered that the inventions patented from time to time during the fifty years of typewriter construction were distributed over the following countries:-

United States of America .	140
Germany	81
Great Britain	12
France	8
Austria	5
Italy	5
Canada	4
Switzerland	4
Holland	2
Japan	2
China	1
Sweden	1
Denmark	1
Belgium	1
Total	267

In every case these represent complete typewriters, not merely the improvement of parts. It must be apparent of course that many of the then current ideas were used, with or without variation, in the new machines which were brought out. Doubtless, other new makes of typewriters will be introduced from time to time, but it would appear that the time is not far distant when the introduction of new makes of typewriters will /

will cease, owing to the extremely hazardous nature of the undertaking of bringing a new machine on the market, due in part to the excessive competition which now exists between the numerous typewriter companies of standing. Drastic reductions of price have already been tried, especially in America, in connection with new machines, but without success.

Notwithstanding the large total figure mentioned above, it may be noted that the number of makes of machines now on the market is far less than that given. In many cases the machines have been withdrawn, sometimes before reaching the production stage, whilst in others financial considerations have prevented the manufacturers from exploiting the markets of the world as they would have liked to do. In not a few cases amalgamations have taken place between the various companies concerned in the manufacture of machines, whilst in several instances, as the result of absorptions, machines have gone out of existence altogether.

Typewriters: Orthodox and Otherwise

Viewed in the light of present day requirements, some of the inventions were extremely crude, though no doubt the aspirations of the inventors were commendable. Mention may be made of the Francis of 1857, which had a keyboard resembling that of a piano, but no platen. The Pastor Hansen Schriebkugel of 1872 contained spring keys which were situated at the top of the machine and which struck the paper stretched over a large semi- /

semi-cylindrical carriage. All the keys struck in the same place, and in order to achieve this result they were spread over a concave fitment and set at different angles in circles. A small machine patented in 1885 was the Columbia, which was the first visible writing machine. The <u>modus operandi</u> consisted of turning a handle in reference to an index plate, and pressing the whole, when the particular letter or cypher had been found. The type on this machine was contained on the periphery of a wheel. Designed to print two cyphers at the same time, hence its name, the Duplex of 1895 contained one hundred keys in eight banks. The Gardner contained a typewheel but only thirteen keys, which served to write seventy-eight characters. Marketed in 1880, the Hall was of unorthodox construction, the writing being accomplished by pressure on a hand piece which acted on a rectangular rubber plate, on which were eighty-one characters in nine rows. Of unusual design departing from the usual keyboard and type bar construction, is the Mignon of 1904, which consists of a long cylindrical type wheel operated by the depression of a stylus on a character indicator. The Scholes Visible of 1909 was also of unusual construction, the type bars being situated at the front of the machine in two vertical banks. When a key was struck, the type bar moved upward slightly and then forward, striking the platen with what is termed a front stroke motion. A French machine which contained /

contained no more than five keys by means of which thirty characters could be printed by the use of combinations, was the Dactyram. In appearance the machine resembled a small key-punching machine and consisted of not more than one hundred and twenty parts, as compared with over two thousand separate parts to be found on modern typewriters. A more recent invention is a typewriter by means of which partly phonetics and partly shorthand are written on a narrow strip of paper. The keyboard contains several duplicate keys; some keys are higher than others, and by means of the grooves thus formed fingering is said to be simplified.

Few details are available of the Chinese typewriter which was invented by a Chinese who was resident in Ne w York at the time. The machine is said to consist of three keys only, one of which is the space key and another the back spacer. Yet withal the machine is supposed to write no fewer than four thousand two hundred characters. It should be noted that the Chinese language contains a large number of differently written signs, it being necessary to know about three thousand such in order to read an ordinary elementary book in Chinese, but by what mysterious combination of three keys such a number of characters can be portrayed is almost beyond the comprehension of the Westerner. Similarly, the Japanese typewriter, which has been on sale since1919, is credited with the ability to write three thousand characters, but, notwithstanding that their literature is /

is still written in Chinese characters, the Japanese commercial community have begun to use the Roman alphabet.

America Foremost in Production

The very brief survey of typewriter development throughout the world, much of which is connected with the period prior to the last half century, and the numerous oddities displayed in some of the inventions, as viewed by present day ideas, serves to show that the typewriter industry is a vast one. The huge factories now operating, principally in America, meet the demand of almost the whole of the world, certainly eighty per cent. of it, the machines destined for service in foreign countries being fitted with the particular characters required in those countries by reason of language differences.

Recent statistics as to the export of typewriters from America show that no less than twenty per cent. of the machines are taken by the United Kingdom, at a cost of over three million sterling per annum.

* * * * *

The great majority of present day models are front stroke machines, that is, those fitted with type bars which are arranged in an almost semi-circular bed, the actual type facing upwards. Incidentally, this method of construction is of benefit when cleaning the type. When the keys are struck, each type bar swivels in an upward and forward motion, striking the platen in the printing position, usually through a type guide.

"The Incorporated Accountants' Journal".
November 1937

APPENDIX No. 6

The History of Accounting Machinery

Fifty years ago all the employees in offices were male. The records were kept in stoutly bound ledgers, and ink stained fingers were the most important tools of the business executive which comprised one man responsible for taking all the important decisions.

The history of accounting machines begins with the elemental machine known as the abacus of the Roman system of notation which are known to have been in use as early as the sixth century B.C. and which are still in daily use in Russia. The older "sangi" or number rods of the Japanese and the "suan-pan" a form of abacus invented and still used by the Chinese are also precursors of the mechanical devices which we know to-day.

In 1642 Blaise Pascal, a nineteen-year-old French lad invented and built an adding machine which has been the foundation for all adding machines. Twenty-nine years later (1671), a young German, Gottfried Wilhelm Leibnitz announced a machine for multiplying, dividing and extracting roots as well as for adding and subtracting. In 1714 Henry Mill, a Briton, was granted a patent for "An Artificial Machine "or Method for the Impressing or Transcribing of Letters, "Singly or Progressively one after another as in Writing, "whereby /

"whereby all Writing whatever may be Engrossed in Paper or "Parchment so Neat and Exact as not to be distinguished from "Print." Except for the title, nothing is known of the machine.

In 1829 William A. Burt obtained a patent for a typographer, but America was largely responsible for the early development of the modern typewriter.

Accounting machinery which is primarily a combination of the counting machine and the typewriter on which not only counting and computing, but also recording, analysing and summarising of transactions are done, is a quite modern invention.

Tabulating machinery (punched card) was patented by Dr. Herman Hollerith in 1889, after a decade of experimentation as a counting machine, and for many years was known as a "censu machine". (International Business Machines Corporation).

By more or less simple modifications, simple machines have gradually become complex. To-day there is nothing that can be written with pen and ink or computed that cannot be done by machinery and done more accurately and faster than by hand. With the single exception of the calculating machine of the sliding carriage type, America has led and still leads in the manufacture and general use of accounting machinery.

The /

The manufacturers of accounting machinery have followed closely the general economic trend of growth and organisation. Almost without exception the present makers are the result of numerous mergers and consolidations. (Moon-Hopkins - Elliot Fisher, Addressograph - Multigraph, Gledhill - Brook, Powers - Samas, Felt & Tarrant, are typical).

The idea of an addressing machine developed in the mind of Joseph S. Duncan who made the first machine which was merely a series of rubber stamps mounted on an endless chain. Offices were opened in Chicago in 1893, the Addressograph Company being organised on 1st January 1896.

The first Burroughs machine was exhibited publicly in 1884, the invention of William Seward Burroughs, then a young man of twenty-seven. It formed the basis for the fundamental patent granted in 1888, the first ever granted for a key-set recording and adding machine. The company introduced its first calculator in 1911 and the electric key-driven calculator in 1928. In 1921, the company acquired the Moon-Hopkins billing and book-keeping machine which was first marketed in 1909.

The first Comptometer (Felt & Tarrant) Adding and Calculating Machines were manufactured just fifty years ago (in 1887) under patents granted in 1886. It is interesting to note that the inventor of these machines, Dorr Eugene Felt, was also a young man of but twenty-three when he built his first /

first machine in 1885. The locking button was introduced in 1913 and the electrified Comptometer made its appearance in 1934.

The Marchant Calculating Machine Company was organised in 1908 by the Marchant brothers, who had been the American agents for a French calculating machine known as the Dactyl.

The Monroe Calculating Machine Company was organised in April, 1912, by Jay R. Monroe and Frank Stephen Baldwin, the inventor of the Baldwin Calculator, the basic principles of which formed the basis of the first Monroe Adding-Calculators which were first exhibited at the National Business Show in New York City in the fall of 1912. Ten years later, the company introduced its first electrically operated machines, and it now manufactures listing and book-keeping machines founded on the Gardner patents.

The National Cash Register Company was formed by John H. and Frank J. Patterson in 1884, and derives its name from its original and principal product, the Cash Register, which, with the exception of the typewriter, is undoubtedly the most widely used business machine. The Class 2000 book-keeping machines were developed in 1922. In 1929 the company acquired the Ellis Adding Typewriter, first manufactured about 1907.

The first part of the name Remington-Rand, Inc., is derived from the original typewriter first marketed in 1874. The /

The attachment of the Wahl adding register to the typewriter in 1908 (acquired by Remington in 1922) converted it into a book-keeping machine. The Smith-Premier, a double-keyboard, no-shift typewriter, was acquired by Remington in 1912 and is still sold abroad under its own name. The Dalton adding machine was invented in 1902 and acquired in 1927. The Powers tabulating machine was invented in 1911 and acquired in 1927.

The Underwood Typewriter Company introduced its first visible typewriter in 1896 and its accounting machines in 1913. In 1927, it merged with the Elliott-Fisher Company which had previously acquired the Sundstrand Corporation. In 1891 Crawford Elliott and Robert J. Fisher each obtained patents on a different machine designed to write on flat surfaces such as provided by bound books, then extensively used. The two companies manufacturing these machines consolidated in 1903. The Sundstrand ten-key adding-listing machine was introduced in 1914.

To-day male clerks have been largely displaced by females who seem to be better adapted physically and temperamentally to the smooth routine of accounting machine operation.

The loose-leaf general and subsidiary ledgers and the books of original entry are posted by machines, and daily summaries of cash transactions, sales, purchases, etc., enable the controller to perform his functions. Financial statements and reports in analytical detail unknown fifty years /

years ago are ready for the management within a few days after the close of each month. Bills and statements to customers are prepared and mailed promptly, almost automatically, by machines.

The business has long since grown from a one-man enterprise into a far-flung corporation with many branch offices and plants, beyond the capacity of any one person to supervise effectively. The office is organised by departments and work is routed and authority and responsibility delegated here just as it is in the factory. The executives dictate into machines where their words are recorded on wax cylinders for transcription by ear-phoned secretaries on quietly rapid electric typewriters.

Just as the man of the most vivid imagination fifty years ago could neither dream of nor comprehend such progress as has been made, so we, to-day, cannot foresee the improvements that will convert our most advanced machines into quaint relics fifty years hence. It is safe to say, however, that if the rate of development continues, the modern office of to-morrow will more than ever resemble a machine shop, and that reliance upon manual operations and susceptibility to human inefficiencies and errors will have been relegated to the then dim past of 1937.

Appendix No. 7

STATEMENT showing the Progress of a Firm Specialising in the Facilitative Aspects of Office Mechanisation.

Year	Number of Employees	Annual Turnover	Capital Employed
1910	104	£ 20,093	£ 12,500
1920	582	239,036	130,000
1930	618	269,343	172,000
1938	704	320,000	172,000

(This Appendix has been prepared from information supplied by the City Education Officer, Edinburgh).

Appendix 8

EDUCATION for COMMERCE in SCOTLAND

The Present Organisation of Commercial Education in Scotland.

The Scottish tradition leans towards laying a good foundation in general education and following this up by part-time education in the theory of commerce and the acquisition of office arts along with practical training in the office, shop or warehouse. Commercial studies are, however, to a largely increasing extent being undertaken in the Day Schools, although commercial subjects only form a relatively small part of the curriculum. The study of business subjects and mangement in their higher branches have also developed in Central Institutions and similar Colleges, and in the Universities. In addition, there are many Private Schools and Colleges mainly situated in the larger towns, dealing with commercial education in which students find a means of rapid intensive individual training not easily obtained under the official education system.

The Organisation of Commercial Education.

(a) Day Schools. - In Scotland, school pupils pass on at the age of about twelve years to some form of advanced instruction.

Courses with a commercial bias are provided in the majority /

majority of large °Day Schools with advanced divisions, and the Day School Lower, Higher, and Higher Leaving Certificates may be taken with a commercial group included. In some cases commercial instruction runs right through the advanced course, but in others it is confined to the concluding year or years. A solid core of general education must be given in every course. In a typical three years' course, therefore, we find that, out of forty periods per week, something like six or seven periods only are devoted to the purely commercial subjects of shorthand, typewriting, book-keeping, and business procedure. In a normal secondary commercial course also, probably nine or ten periods might be so absorbed, including, in this case, economic geography and commercial arithmetic. A most useful development in recent years has been a fourth-year intensive commercial course for pupils from 15 to 16 years of age who have already followed, in most cases, a three years' course of general education. This type of course is finding increased popularity both among pupils and employers. The extent to which commercial subjects have gained ground in the Day Schools of Scotland can be gauged from the figures here given. A certain measure of commercial instruction has also been developing in the Junior Instruction Centres and the Day Continuation Classes for unemployed juveniles.

(b) Continuation Schools. - Evening Continuation Classes in commercial subjects are conducted by the majority of local education /

education authorities in Scotland. The instruction differs greatly from that in the Day Schools in as much as the students are actively engaged in and, accordingly, better acquainted with the realities of commerce. The importance of commercial education in the Continuation School system may be gathered from the fact that in an urban area like Edinburgh, almost one-third of the teaching staff and students are engaged in commercial studies.

The commercial instruction in Continuation Schools is still, however, of an elementary nature. The subjects are arranged in groups suitable to those following different commercial occupations. A complete elementary evening course very often consists of English, arithmetic, book-keeping, practice of commerce, shorthand and typewriting. A special branch of commercial education which has been developed in some areas is that dealing with salesmanship or those engaged in the distributive trades. Nowhere in Scotland, apart from the University of Edinburgh of which mention will be made later, is a practical training given in office mechanisation.

Apart from local examinations and external examinations such as the R.S.A., students in Continuation Classes and Central Institutions are eligible for the examinations of the National Committee (Scotland) for Commercial Certificates, which is a body representing education and commerce. The issue of certificates /

certificates is controlled by the Scottish Education Department. The majority of the local authorities in Scotland are represented on this Committee through four Regional Committees centred in the cities, and it is expected that with the growing importance of the certificates, the schemes of these authorities in regard to commercial education will be influenced to an increasing degree by the policy of the National Committee.

Instruction is given in the Central Institutions and similar Colleges of a more advanced or specialised nature. These Central Institutions are in somewhat the same category as the larger Technical Institutes in England. A very large proportion of the students are engaged in commerce or administrative work concurrently with their studies. The courses of study lead to diplomas and to various external and professional examinations. The principal Colleges of this type are the Glasgow and West of Scotland Commercial College, the Heriot Watt College, Edinburgh, and the School of Economics and Commerce, Dundee. Commercial instruction in the evening classes of each region is controlled by a scheme of affiliation to the Central College.

Universities.

In the case of Edinburgh, through the generosity of Mr Albert Thomson, a laboratory for the training of commerce students in the problems of office mechanisation has been instituted /

instituted, and will provide unique opportunities for the co-ordination of theoretical study and practical application at an impressionable stage in the students' carreers. The "mechanics" of office organisation cannot well be studied in any other way. Two of the Scottish Universities, Edinburgh and Aberdeen, have departments leading to degrees in commerce. The courses are designed to meet the needs of those seeking a career in the higher ranks of commerce or administration. They are largely taken advantage of by students of the accountancy profession. The commercial world has been slow to take advantage of this development and the attempt being made in Edinburgh to relate instruction in the department of commerce to practical commercial affairs through a laboratory in which business pursuits and plans are carried through and in which the highly mechanised nature of modern business operations are linked up with more theoretical studies, marks one of the greatest advances in commercial education of modern times.

Relationship between Education and Commerce.

Although it is not easy to assess the largely undetermined requirements of commerce, it is fair to say that the product of the commercial courses of Scottish Schools and Colleges finds a ready place in commercial employment. There is evidence of the growth of a healthy spirit of co-operation between the business /

business community and educational interests in the education, selection and training of entrants to commerce. This is shewn most clearly in the willing help afforded by business men in the working out of the Scottish Scheme for Commercial Certificates and in the advisory work in connection with the development of Continuation Classes where the keen interest and intimate knowledge of trade requirements of the business representatives are invaluable. Many problems remain to be solved, such as the stage at which specialised instruction in commercial subjects should be superimposed upon general education, and a great deal remains to be done in bringing the courses more into line with everyday commercial thought and practice.

Whether this question will be solved by developments in the degrees for commerce or whether it will be best attained by some system under which the aspirants towards the higher branches of business administration become acquainted with practical affairs concurrently with academic studies, remains to be discovered, but it appears that unless and until the main principles underlying office mechanisation are more fully enunciated in some authoritative work, the supply of adequately trained administrators in this sphere will continue to be inadequate to the needs of trade and industry.

SCOTLAND

Year	Number of Pupils studying Commercial Subjects in Day Schools	Number of Pupils studying Commercial Courses in Continuation Classes	Total
1930	16,873	24,400	41,273
1931	18,336	23,415	41,751
1932	16,763	22,376	39,139
1933	18,183	20,187	38,370
1934	18,229	19,064	37,293
1935	18,441	20,050	38,491
1936	18,671	20,309	38,980

Note: The effect of the industrial depression is reflected in the diminished numbers in 1932-34.

APPENDIX No. 9

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Modern /

Extract from "Economist"
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Appendix No. 10.

THE DISTRIBUTION OF NATIONAL CAPITAL

Although the work of the thrift associations and the building societies, the generally higher standard of wages and the greater choice of facilities now available to the small investor are all helping to bring about a more equitable distribution of capital, the process is a very slow one, and a most interesting article in the "Westminster Bank Review" shows that the ownership of capital is still concentrated in a comparatively small proportion of the population.

The total national capital to-day is estimated at £20,000 million. Of personal capital in the narrow sense, stocks and shares, which are mainly the investments of the wealthier classes, represent 31.5 per cent. or nearly one-third of the total; the next largest class but less than half the first, is British Government securities issued since 1914, which amount to 15.4 per cent. house property and business premises come next (13.4 per cent.) and then comes a big drop, the remaining classes being in the following order: money lent on mortgages, bonds, etc., 8.7 per cent.; Government and municipal securities other than post-1914 British Government securities, 7.6 per cent.; cash (including savings bank deposits) 7.3 per cent.; land, ground rents and mineral rights, 4.1 per cent.; insurance policies, 3.9 per cent.; trade assets, 3.2 per cent.; household goods, 2.0 per cent.; other /

other property, 2.9 per cent.

The following table, based on the estate duty returns of 1924-30 shows the distribution of the total national capital in income groups:-

(1924-1930)

	Persons (Age 25 and over) Number	%	Capital £ million	%
£100 or less	17,052,000	76.3	500	3.2
£100 - £1,000	3,862,000	17.3	1,632	11.1
£1,000 - £5,000	1,035,000	4.6	2,610	17.7
£5,000 - £10,000	192,000	0.9	1,519	10.3
£10,000 - £25,000	125,000	0.6	2,177	14.8
£25,000 - £100,000	68,000	0.3	2,813	19.1
Over £100,000	11,000	0.05	3,504	23.8
	22,335,000	100	14,755	100

It can be seen that while less than 1 per cent. of the adult population had an annual income of over £10,000 they together owned over half the total capital, and the richest class, one adult person in every 2,000, together owned nearly a quarter of the whole. As estates increase in size, stocks and shares increase in importance and house property declines. In estates ranging from £100 to £1,000 house property constitutes 30 per cent. of the capital and stocks and shares only 5.6 per cent.; from £1,000 to £5,000 the percentages are 23 per cent. and 15.6 per cent. respectively; the position changes as estates rise in value until in estates of over £100,000 stocks and shares are 41 per cent. The low percentage /

percentage of insurance policies shows that this country is still far from being "insurance conscious"; they form 9.8 per cent. of the estates between £100 and £1,000, but only 2.4 per cent. of the £25,000 to £100,000 class. Above £100,000 there is a rise to 3.1 per cent. which presumably reflects insurance against estate duties.

It is clear, therefore, that the spread of capital is still unequal, but factors which are surely, if very slowly, lessening the inequality are the expansion in house ownership which enables a higher standard of living and greater saving to go hand in hand, and the high rates of estate duties which are gradually reducing the largest holdings of personal capital. The article also points out that the benefits of capital ownership are much more widely distributed than formerly. The National Health and Unemployment Schemes, and particularly the Pensions Schemes which have just been extended by the new Act, provide at least a modicum of security for those who are unable to accumulate capital for themselves.

STATEMENT of the Total Number and Nominal Capital of New Companies registered under the Companies Acts, including Companies already in existence which have been registered under the Companies Act for the first time.

Years	No.	Nominal Share Capital	Average Nominal Share Capital
1862-65	102	£13,490,652	£132,261
1866-70	116	7,567,120	65,234
1871-75	306	27,083,070	88,507
1876-80	356	32,277,952	90,668
1881-85	498	74,110,544	148,816
1886-1890	600	45,905,616	76,509
1891-95	978	39,028,318	39,906
1896-1900	1,705	84,274,819	49,428
1901-05	1,266	38,844,203	30,683
1906-10	1,705	41,729,813	24,475
1911-15	1,763	31,979,119	18,139
1916-20	2,051	68,413,186	33,356
1921-25	2,376	49,409,646	20,795
1925-30	2,325	58,191,352	25,029
1931-35	2,598	25,368,478	9,765
1936	638	5,180,303	8,120

STATEMENT of Considerations involved in a particular case affecting the introduction of addressing machinery.

This appendix is intended to illustrate the detailed examination necessary before a decision is taken to instal any particular addressing plant, but after the desirability of mechanisation has been determined.

A. Considerations	B. Observations
1. Total number of plates	1. Depends on space (lines and letter spaces) available in plates, on the automatic availability of parts of plates through the use of cut-out pads and selector arrangements.
2. Annual increase in the number of plates on the basis of an average increase of 7,000 subjects per annum.	2. Depends on 1.
3. Number of trays.	3. - 6. Depends on 1 and capacity of trays (see 4). Price of installation is affected by such matters.
4. Number of plates in each tray.	
5. Number of cabinets.	
6. Number of trays in each cabinet.	
7. Number of printing machines.	7. Depends on time available for doing important work. Peak loads may have to be provided for at all costs. Speed of operation - whether single or multiple head printers are to be used.
8. Number of embossing machines.	8. Depends on whether original embossing is to be undertaken and on the amendments nedessitated on plates, whether selections are embossed or tabbed, and whether one-piece or panel plates are employed.

9. Type of embossing machine.
   Speed of embossing -
   (a) Wheel
   (b) Keyboard

10. Weight of each plate.

11. Weight of one full tray -
    Adrema 200 plates
    Addressograph 190 per tray.

12. Weight of each full cabinet.

13. Weight of the complete installation.

14. Number of effective alterations per plate.

15. Time taken to dismember 100 plates, blank out, re-emboss a name, and re-insert changed index card.

16. Reference numbers.
    Survey Book - Ward, Book, Page and Item numbers.
    Requisitions and Valuation Notices - Ward, Book, and Item numbers.
    Valuation Roll and Ledger - Item number.

    Demand Notes - Ledger reference numbers.

17. Mechanical efficiency of the machine.

18. Amount of handling of plates.

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9. Depends on type of plant selected. If typists accustomed to standard keyboard will be employed on embossing, this may influence decision.

10. Floor strength may call for consideration. Location of
\- plant may be influenced by weight. A recent installa-
13. tion in Edinburgh weighed 24 tons including plates.

14. Depends on type of plate, e.g. separate index or readability of amended plates, whether panel or one-piece plate, durability of metal or position incidence of amendment and relative permanence of information embossed on plates.

15. Depends on type of plates in use, on type of embossing machine and whether selectors are embossed or tabbed.

16. Depends on the system of referencing and on the degree of automaticity of the machine to serially number without embossing, also on use of cut-out pads. This requires careful working out to secure balance of advantage.

17. Depends on servicing, reputability of firm. Reports from other users are helpful.

18. Depends on type of printing machine (single or multiple head) and on selector system.

19. Facility in handling plates.	19. Depends on weight, readability, indexibility and principle of selections.
20. Facility in handling full trays.	20. Depends on weight.
21. Speed embossing new plates. 22. Speed embossing and effecting alterations on old plates.	21. & 22. Depends on training of operators, on type of embossing machine and on form of selections.
23. Identification of plates. 24. Facility of reference to plates.	23. & 24. Depends on arrangement in trays and on type of plate.
25. Estimate time to print. Survey books containing 150,000 entries, Requisitions, Valuation Notices, Valuation Roll, Ledger, Demand Notes, Supp. Survey Books, Supp. Requisitions, Valuation Notices, Valuation Ledger, Val. Demand Notes.	25. Depends on nature of work, on type of printer, on nature of forms to be handled, on number of copies required at one operation, on number of machines available and other factors.
26. Style and lay-out of Survey Books. Valuation Roll, Ledger, Demand Notes, Requisitions, Valuation Notices.	26. Depends on type of printing head (back to front or side).
27. Accident safety devices.	27. Depends on make of machine
28. General facility and easiness in operation of machines.	28. Ease in change of settings is important and the principle of selection must be studied in this connection.
29. General efficiency, absence of loss of time handling papers, plates and trays, etc. 30. General flexibility of the whole system and adaptability to cope with new factors and changes, etc.	29. & 30. Make of machines must be judged also according to general impressiong and the system best suited to the nature of the business.

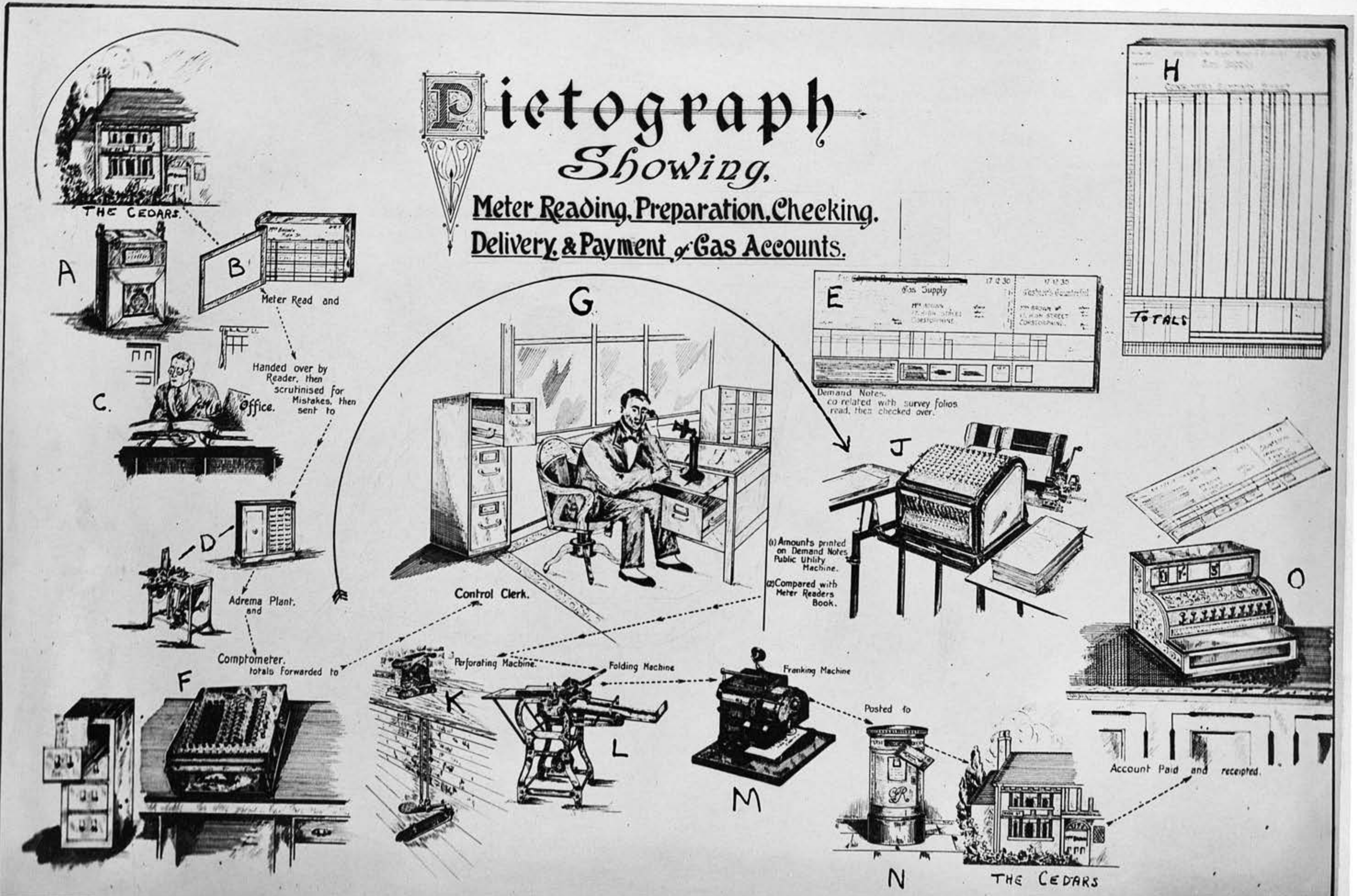
31. Work involved remedying the result of plate or printing errors.	31. While plate errors will be the most common, there are cases where defective impressions, particularly in regard to reference numbers can cause a great deal of trouble. Perfection of impression (embracing carbon copies) is therefore important.
32. Ability of the system to cope with peak-loads.	32. Depends on machines available, speed of operation, etc.
33. Number of permanent operators required to work the system.	33. & 34. Depends on number of printing machines, amount of amendment of plates and peak loads.
34. Number of additional operators required in a temporary capacity at busy periods.	
35. Estimated initial cost.	35. & 36. A matter of computation, but initial cost must be considered in the light of daily service and running costs compared with 37.
36. Estimated annual cost of renewals, upkeep and maintenance.	
37. Estimated ultimate annual saving in salaries.	37. Depends on <u>status quo</u> before mechanisation and trend of business. Margin for expansion in machine equipment proposed.
38. Services in the case of breakdowns.	38. Depends on nearness of service depots and effective organisation of firm supplying machines.
39. Effect on the machines and plates in the case of damage by fire or water.	39. Depends on nature of plant.
40. Life of machines.	40. Depends also on nature of plant, extent in use, etc.
41. Period in which it is estimated the initial cost will be met by annual saving in salaries, etc.	41. Depends on 35-37 and 40.

42. Quality of carbon copies.	42. An important consideration. Depends on quality of paper used. Owing to the use to which documents addressed are to be put some restriction may be necessary in suiting paper to machine work. Depends also on carbon paper used. Sometimes different qualities are necessary for addressing operation than is desirable for subsequent operations (e.g. accounting machinery). Method of obtaining plate impression is also a factor in quality of carbon copies
43. Common plant with other departments.	43. Interchangeability of machines and plates with plant of other departments creates a source of departmental co-operation in difficult situations. Pooling of resources is always desirable.
44. Number of selections left for us.	44. Certain selections may be taken up for enhancing the automaticity of the printing operation with consequent reduction in the number available for pure selective purposes. Total number of selections and number required for machine purposes determine number available. These of course may be made to serve different purposes under different "plans".
45. Cost of replacement of plates.	45. Depends on type of plate, (panel or one-piece) initial costs, etc., and number of alterations which can be made with safety.
46. Number of "padding" plates, Owner and Occupier.	46. Depends on system of "stopping", on selections, and on the tray arrangements.
47. Automatic stencilling.	47. Depends on the type of machine. If fixed (stencil) and variable (plate), information can be "married" in operation, the use of the machine can be considerably extended.

48. Maximum size of sheet that can be handled conveniently with carbon papers in.	48. Depends on the make of machine (side or back to front throw).
49. Tabbing - (a) Number of selections left after completely actuating machine for the work. (b) Is the creation and elimination of selections a separate operation from emboss; ing? (c) Cost of selections per 1,000.	49. (a) see 44. (b) and (c) Embossed selections involve no additional costs apart from labour.
50. Facilities for tabbing of plates in drawers.	50. Indexibility is enhanced where top edge of plates is not wholly required for selections. On the other hand, tabbed plates contain an index card. Additional index plates can be used in either case.
51. Degree of self actuation (a) at bottom of sheet (b) at head of page (c) Serial number in valuation roll.	51. Affects the degree of attention required for operation.
52. Conversion of double to single head.	52. Depends on make of machine, instantaneous in one case and more difficult in other.
53. Sorting back of plates out for amendment.	53. Depends on readability of plates and method of indexing.
54. Facilities for embossing first equipment of plates.	54. Depends on the availability of original documents to let out to contractor or whether embossing must be done on the premises.
55. Facilities for additional quasi-permanent information.	55. Amount of plates not taken up in first place.
56. Water Charges.	56. Special to this case, but involves a consideration involving the automatic interworking of an appropriate cut out pad (on multiple head) with a selector.

57. Preparation of Demand Notes in duplicate.	57. Number of prints involved to complete a document and the amount of movement of paper to achieve this end depends on (a) facilities for carbon work, and (b) nature and size of form.
58. Type face on plates.	58. Whether pica, elite, etc. is to be used. The smaller the type the more can be put on the plate.
59. Mass embossing, e.g. new street.	59. Depends on the degree to which automatic embossing can be applied. Important when the same street has to be repeated on numerous plates.
60. How long to deliver after placing of order.	60. Depends on firm, stocks held, etc.
61. Mass blanking out.	61. Depends on degree to which automatic blanking out of plates (and if necessary levelling) can be carried out either locally or by supplying firm.

Other points emerged in the course of this particular investigation, but these matters were considered at the time when no decision as to type, make, etc., of machine had been determined.



Pictograph
Showing,
Meter Reading, Preparation, Checking.
Delivery, & Payment of Gas Accounts.
A
THE CEDARS.
B
Meter Read and
C.
Handed over by Reader, then scrutinised for Mistakes, then sent to
Office.
D
Adrema Plant, and
Comptometer.
totals forwarded to
F
G
Control Clerk.
E
Gas Supply
Demand Notes.
co-related with survey folios read, then checked over.
H
TOTALS
J
(1) Amounts printed on Demand Notes Public Utility Machine.
(2) Compared with Meter Readers Book.
K
Perforating Machine.
Folding Machine
L
Franking Machine
M
Posted to
N
THE CEDARS
O
Account Paid and receipted.

Diagram illustrating a Method of Machine Accounting

A call is made at, say, "The Cedars" by a Meter Reader, and the meter illustrated (A) is read and recorded in the meter reading book, a facsimile of which is given (B). The book is handed over to a clerk (C) who examines cursorily to detect any obvious discrepancy. The addressing plant (D) then partly prepares the Demand Notes (E) with name, address and other quasi permanent particulars while the Comptometer Operators (F) calculate and extend and enter charges into meter book and accumulate grand totals for each book, furnishing the control clerk (G), with these amounts.

Thereafter, Demand Notes (E) and a summary sheet (H) are inserted in a Public Utility Machine (J) and the Demand Notes completed with charges from Meter Books (B) On completion of each book, "total keys" print in the summary sheet the total for that book and this total is cross checked by the Control Clerk who already has in his possession the predetermined comptometer total. Demand Notes are then perforated (K) in bundles with date of issue (for discount purposes) folded by machinery (L) into manner and size suitable for window envelopes, inserted in envelopes, franked (M), posted (N), and delivered to "The Cedars". Later the Demand Note is presented for payment when stub is detached automatically by cash register (O) which furnishes the receipt.

Appendix 13

CONTENTS.

Art. No.	DESCRIPTION AND SIZE.	Price per Denomination.					
	Malleable Bends.						
A 36 A	4″	.... each.					
B	3″	.... ,,					
C	1¼″	.... ,,					
D	1″	.... ,,					
E	¾″	.... ,,					
F	½″	.... ,,					
G	¼″	.... ,,					
	Malleable Crosses.						
A 37 A	1″	.... each.					
B	1″ × ½″	.... ,,					
C	¾″	.... ,,					
D	½″	.... ,,					
E	⅜″	.... ,,					
	Malleable Knees.						
A 38 A	4″	.... each.					
B	3″	.... ,,					
C	2″	.... ,,					
D	1½″	.... ,,					
E	1¼″	.... ,,					
F	¾″	.... ,,					
G	½″	.... ,,					
H	⅜″	.... ,,					
	Malleable Nipples.						
A 39 A	4″	.... each.					
B	3″	.... ,,					
C	2½″	.... ,,					
D	2¼″	.... ,,					
E	2″	.... ,,					
F	1½″	.... ,,					
G	1¼″	.... ,,					
H	1″	.... ,,					
I	¾″	.... ,,					
J	½″	.... ,,					
K	⅜″	.... ,,					
L	¼″	.... ,,					

CONTENTS.

Art. No.	DESCRIPTION AND SIZE.	Price per Denomination.					
	Brackets—contd.						
72							
73 A	Backplates for Brackets, Assorted ...	each.					
B	Do. do. 6328	,,					
74							
	Bowls.						
	Smith's Col'd Bowls—						
75 A	74252, complete with Chains and Studs	each.					
B	74504, do. do. do.	,,					
C	74279, do. do. do.	,,					
D	74141, do. do. do.	,,					
E	73589, do. do. do.	,,					
F	73991, do. do. do.	,,					
76							
	Welsbach Col'd Bowls—						
77 A	9543, complete with Chains and Studs ...	each.					
B	5978, do. do. do. ...	,,					
C	6903, do. do. do. ...	,,					
D	9931, do. do. do. ...	,,					
E	6902, do. do. do. ...	,,					
F	6901, do. do. do. ...	,,					
78	11″ Vitreosil Bowl	each.					
79	$12\frac{1}{8}$″ Clear Bowl	,,					
80	$8\frac{3}{8}$″ Clear Bowls	,,					
81	8″ Opal Bowls	,,					
82	$7\frac{1}{4}$″ Opal Bowls	,,					
83	$7\frac{3}{4}$″ Suggs Littleton Bowls	,,					

Appendix 14

List of Account Heads with various Code Nos. and Details of each.

Account.	Description.	Cost Heads.	Details.	Further Details.
1	**LOAN ACCOUNT.**	101/199		
				Includes:—
2/43	**CAPITAL ACCOUNT.**	200/4399		300 Granton Works Site, including Craigleith Quarry and Main.
				400 Buildings, Machinery and Plant.
				500 Vertical Retorts and Plant.
				600 Washing Plant and Condensers.
				700 Coke Handling and Screening Plant.
				800 Gasholders.
				900 Station Meters.
				1000 Boosting Plant.
				1100 Sulphate of Ammonia Plant.
				1200 Purifying Plant.
				1300 Exhausters.
				3000 Railway Wagons.
				4000 Office Furniture.
51	**COAL.**	5101	Coal.	
		5102	Coal Haulage.	
		5103	Running of Coal Testing and Experimental Plant (exclusive of Repairs to Plant—see 5799).	
		5104	Storing Coal.	
		5105	Lifting Coals from Stock.	
		5106	Examining Tubes on Coal Bing.	
		5107	Picking Stones from Coal.	
		5108	Coal Traffic and Inspection.	
		5109		
		5110		
		5111		
		5112		
		5113		
		5114		
		5115/5199		
52	**GAS OIL and COKE for Blue and Carburetted Water Gas.**	5201	Oil Account.	
		5202	Oil Carriage.	
		5203	Coke.	
		5204	Pumping Oil into Storage Tanks.	
		5205		
		5206		
		5207		
		5208		
		5209		
		5210		
		5211/5299		
53	**WAGES—CARBONIZING.**		**VERTICAL RETORTS.**	
		5301	Supervisors and Foremen.	
		5302	Coalmen, Breaking, Elevating and Conveying.	
		5303	Chargers.	
		5304	Dischargers.	
		5305	Producer Men.	
		5306	Pipemen and other duties.	
		5307	Scurfers.	
		5308	Coke Screen and Storage Attendants.	

Account.	Description.	Cost Heads.	Details.	Further Details.
55	GENERAL WORKS CHARGES—contd.	5535 5536 5537		
		5599	General Purposes.	Small Purifiers and Test Recorders, etc. (Carbonizing), Parks and Plantations, Oil and Grease for running of Plant (for subsequent transfer to R. and M.)
56	PURIFICATION—OXIDE OF IRON and WAGES	5601	Oxide of Iron.	
		5602	Enginemen.	
		5603	Charging Boxes.	
		5604	Discharging Boxes, Cleaning and Repairing Grids.	
		5605	Lifting and Elevating Oxide.	
		5606	Preparing Oxide on Floor.	
		5607	Loading Spent Oxide.	
		5608	Unloading New Oxide.	
		5609	Carriage of Bog Ore.	Includes Dock Charges, etc.
		5610 5611 5612 5613 5614 5615/5697		
57	REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.		C.W.G. PLANT.	
		5701	Generators.	Repairs and Maintenance of Generator No. 1. Generator No. 2. Generator No. 3. Generator No. 4.
		5702	Conveyors, Elevators and Bunkers.	Repairs and Maintenance of— Elevator No. 1. Elevator No. 2. Conveyor No. 1. Conveyor No. 2. Bunker No. 1. Bunker No. 2. Hopper No. 1. Hopper No. 2. Lifting Rams. Screen. Charging Bogies.

Account.	Description.	Cost Heads.	Details.	Further Details.
57	REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.	5703	Engines, Pumps and Steam Pipes, etc.	Repairs and Maintenance of— Blower Engine No. 1. Blower Engine No. 2. Exhauster Engine No. 1. Exhauster Engine No. 2. Conveyor Engine. Elevator Engine. Shafting. Circulating Water Pump No. 1. Circulating Water Pump No. 2. Oil Pump No. 1. Oil Pump No. 2. Syphon Pump. Tar Pump. Steam Pipes. Steam Cocks. Superheater No. 1.
		5704	Washers, Meter, Holder and Connections.	Repairs and Maintenance of— Washer No. 1. Washer No. 2. Washer No. 3. Meter and Connections. Rotary Meter. Holder, Pulleys, etc., and Connections.
		5705	Oil and Tar Tanks, etc.	Repairs and Maintenance of— Oil Tank and Connections. Tar Tank and Connections and Tar Well. Cleaning Tar Separator. Emptying Oil Butts.
		5706	Gauges, Water Pipes, etc.	Repairs and Maintenance of— Gauges and Recorders. Water Pipes and Hose Pipes.
		5707	Brickwork.	Laying new Brickwork. Removing old Brickwork and Cleaning up.
		5708	General.	Repairs and Maintenance Work, not indicated by the above and which cannot be classified under any of the foregoing, for example:— Repairing Cement Floor. Repairing Floor Plates. Repairing Drains. Glazing. Tarring. Clearing away Scrap or Rubbish. Preparing Plant for Action, Oiling, etc., or Standing by. *N.B.*—This heading does not cover:— (*a*) Paintwork—see *5766*. (*b*) Tools and Implements—see *5734*. (*c*) Repairs to Buildings, Roofs, etc.—see *5768*.

Account.	Description.	Cost Heads.	Details.	Further Details.
57	**REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.**	5709 5710		
			INCLINED RETORTS AND FITTINGS.	Inclined Retorts and Fittings.
		5711	Ovens and Producers.	Repairs and Maintenance of— Bench A.1. Bench A.3. Bench B.2. Bench B.4. Bench C.1. Bench D.2. Producer Bars. Water Supply Connections for Benches. Making up Fireclay. Cleaning Tops of Benches.
		5712	Condensers, Liquor and Water Tanks and Coolers.	Repairs and Maintenance of— Condenser No. 1. Condenser No. 2. Condenser No. 3. Condenser No. 4. Condenser No. 5. Condenser No. 6. Condenser Connections to Purifier.
		5713	Ascension Pipes and Retort Fittings (including Gas Main).	
		5714	Hydraulic Plant (excluding Engines).	Pressure Mains. Accumulator. Charging and Drawing Chutes. Compound Valves. Rams. Capstan. Lifting Rams. Hydraulic Pipes and Flanges, Retort House. Cement Repairs. Hydraulic Pipe Track.
		5715	Coke Conveyors, Screening and Storing Plant.	
		5716	General.	
			WATER SUPPLY.	
		5717	Water Pumps and Boiler (Craigleith).	
		5718	Water Pipes and Valves (Craigleith).	
		5719	Water Pumps and Turbines (Granton).	
		5720	Water Pipes and Valves (Granton).	

58-60

Account.	Description.	Cost Heads.	Details.	Further Details.
57	**REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.**		**CARBONIZING MACHINERY.**	
		5721	Coal Breakers.	Coal Breaker Nos. 1, 2, 3, 4.
		5722	Coal Elevators.	Coal Elevators No. 1, 2, 3, and 4.
		5723	Coal Conveyors.	Coal Conveyor Nos. 1 and 2.
		5724	Coal Bunkers and Storage Plant.	Coal Bunker A.1. Coal Bunker A.3. Coal Bunker B.2. Coal Bunker B.4. Coal Bunker C.1. Coal Bunker D.2. Coal Storing Plant.
		5725	Shafting, etc.	
			PURIFIER PLANT.	
		5726	Elevators, Diggers, Engines, etc.	Box Elevators, Digger Elevator. Digger Engine, Box Engine. Boxes. Hydraulic Cranes. Engine House.
		5727	A. Section Purifiers.	
		5728	B. Section Purifiers.	
		5729	C. Section Purifiers.	
		5730	D. Section Purifiers.	
		5731	Water and Steam Pipes, Fittings, etc., and General.	Steam, Gas and Water Pipes. Valves, etc. Seal Pipes. Canvas Chutes. Repairing Concrete. Gangways and Handrails. Platforms and Stairways. Anti-Freezers. Hydraulic Pipes, Pumps and Valves. Floor Plates, Drains. Gauge Pipes. Liquor Pipes. Crests and Shields. Columns and Beams. Reglazing. Cleaning up. Syphon Pipes. Minor Repairs to Building. Repairing Grids. Repairing Canvas Chutes.
		5732 5733		
			TOOLS AND IMPLEMENTS.	
		5734	C.W.G. Plant.	
		5735	Inclined Retorts.	
		5736	Vertical Retorts.	
		5737	Purifier Plant.	
		5738	Stirling Boilers.	
		5739	Tools—General.	
			Note.—For R. P. Wks. Tools, see 8315.	

Account.	Description.	Cost Heads.	Details.	Further Details.
57	**REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.**		**ENGINES AND EXHAUSTERS, SCRUBBERS, Etc.**	
		5740	Coal Breaker Engines.	Repairs and Maintenance of— Coal Breaker Engine No. 1. Coal Breaker Engine No. 2. Coal Breaker Engine No. 3. Coal Breaker Engine No. 4.
		5741	Hydraulic Engines.	Repairs and Maintenance of— Hydraulic Engine No. 1. Hydraulic Engine No. 2. Hydraulic Engine No. 3. Hydraulic Engine No. 4.
		5742	Exhauster Engines.	Repairs and Maintenance of— Exhauster Engine No. 1. Exhauster Engine No. 2. Exhauster Engine No. 3. Exhauster Engine No. 4.
		5743	Pumping Station Engines.	Repairs and Maintenance— Pumping Stn. Engine No. 1. Pumping Stn. Engine No. 2. Pumping Stn. Engine No. 3.
		5744	Scrubber Engines.	Repairs and Maintenance— Scrubber Engine No. 1. Scrubber Engine No. 2. Scrubber Engine No. 3. Scrubber Engine No. 4. Scrubber Engine No. 5. Scrubber Engine No. 6. Scrubber Engine No. 7. Scrubber Engine No. 8.
		5745	Exhausters.	Repairs and Maintenance of— Exhauster No. 1. Exhauster No. 2. Exhauster No. 3. Exhauster No. 4. Exhauster No. 5. Exhauster No. 6. Exhauster No. 7. Exhauster No. 8.
		5746	Steam Pipes, etc.	Steam Connections, etc.
		5747	Boosters.	Booster. Governor.
		5748	Scrubbers, Washers, Tar Extractor and Liquor Pumps and Test Fittings.	
		5749	Workshops, Engines, Shafting, etc.	
		5750		

Account.	Description.	Cost Heads.	Details.	Further Details.
57	**REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.**		**LOCOS AND CRANES.**	
		5751	Locomotives.	Repairs and Maintenance of— Locos. Nos. 1, 3, 4, 5, 7, 8, 9, 10, 11.
		5752	Loco. Cranes.	Loco. Cranes No. 1, 2, 3, and 4.
		5753	Hydraulic Cranes.	Hydraulic Cranes No. 1, 2 and 3.
		5754	**METERS AND CONNECTIONS.**	
		5755	**GASHOLDERS.**	
		5756	**MAINS AND PIPES IN YARD.**	Includes Drains, and one man on General Maintenance.
		5757	**GENERAL PURPOSES.**	Empties, Carriage on Stores, etc.
		5758	Wagons (Railway).	
		5759		
		5760	**PERMANENT WAYS.**	Repairs and Maintenance of— Points and Crossings. N.E.S. and West Yards. Light Railways. R.P. Works and Sea-tip. Lines to Quarry. Purifier and other Roads. Points, Crossings, Blades, Cutting Rails, etc. Woodwork for Point Boxes, Keys, etc. Discharging Sleepers, Rails, Screwing Bolts. Weeding and Cleaning Lines. Excavating and Making New Sidings. Maintenance charges generally.
			STIRLING BOILERS.	
		5761	Stirling Boilers.	Repairs and Maintenance of— Stirling Boilers Nos. 1, 2, 3, 4, 5, 6. Tubes, Flues, Fire-bars.
		5762	Elevators and Conveyors.	Repairs and Maintenance of— Elevators and Conveyors Nos. 1 and 2. Chutes Nos. 1 and 2. Bunkers Nos. 1 and 2. Elevator Engines. Hydraulic Rams.
		5763	Feed Pumps.	Repairs and Maintenance of— Feed Pumps Nos. 1, 2, 3, and 4.
		5764	Hoppers, Pipes and General.	Repairs and Maintenance of— Steam Pipes and Connections Nos. 1 and 2. Hoppers, Hydraulic Rams. Floors, Steam Range. Superheaters, Water Connections. Mixing Caustic Soda, Cleaning Boiler House, Concrete, Floors, Drains, Water Tanks, Gas Pipes, Handrails, Water Pipes.

Account.	Description.	Cost Heads.	Details.	Further Details.
57	REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.	5765	Brickwork.	Repairs and Maintenance of— Brickwork.
		5766	PAINTWORK AND WHITEWASHING.	At Exhauster House. Technical Office. Plant House. Purifier Houses. Station Buildings. Gasholders. Condenser Houses. Meter House. Pump House. Canteen and Workshop Roof. No. 2 Coal Breaker Shed. Station Buildings Bridge. Canteen Boiler Pipes. Gatehouse and Gates. Workshops, Notice Boards. Lamps—Painting or Yard. Washing down Ceilings, Walls, etc. Flagpoles, Windows, Doors, etc. Whitewashing. At Condenser Houses. Plant Houses. Station Buildings. Purifier Lavatory. Workshop Lavatory. C.W.G. Lavatory. Meter House. Pumping Station. Engineroom No. 2. C.W.G. Plant, etc. *N.B.*—This heading does not include Paintwork at Properties other than Works (see A/cs. 11501-3 and 5767).
		5767	Repairs to Properties—Not Let.	Properties occupied by Officials on a non-rental basis.
		5768	Repairs to Buildings, Roofs, etc. (Works).	Includes Alterations, Demolitions, etc., Fences, Glazing, Fountains, Lamps, etc.
		5769		
		5770	COKE RECOVERY AND ASH PLANT.	
			VERTICAL RETORTS.	
		5771	Electrical Equipment — General Maintenance.	
		5772	Bench A. Brickwork.	
		5773	Bench B. Brickwork.	
		5774	Conveyor A.	
		5775	Conveyor B.	
		5776	Conveyor C.	
		5777	Conveyor D.	

Account.	Description.	Cost Heads.	Details.	Further Details.
57	REPAIRS AND MAINTENANCE OF WORKS and PLANT, TOOLS, IMPLEMENTS, Etc.—contd.	5778	Waste-heat Boilers No. 1.	
		5779	Waste-heat Boilers No. 2.	
		5780	Waste-heat Boilers No. 3.	
		5781	Waste-heat Boilers No. 4.	
		5782		
		5783	Screens, Hoppers, etc. and Hydr. Capstans.	
		5784	Producers Bench A.	
		5785	Producers Bench B.	
		5786	Patching Retorts A.	
		5787	Patching Retorts B.	
		5788	Steam and Gas Engines (Power House), Pumps, etc.	
		5789	Gauges.	
		5790		
		5791	Shuttleband Coke Conveyors.	
		5792	Retort Mountings.	
		5793		
		5794		
		5795		
		5796		
		5797	General.	
		5798	Steam Mains and Connections.	
		5799	EXPERIMENTAL PLANT (REPAIRS).	Includes Old and New Plants.
58		5801		
		5802		
		5803		
		5804		
		5805		
		5806		
		5807		
		5808		
		5809		
		5810/5899		
59		5901		
		5902		
		5903		
		5904		
		5905		
		5906		
		5907		
		5908		
		5909		
		5910/5999		
60		6001		
		6002		
		6003		
		6004		
		6005		
		6006		
		6007		
		6008		
		6009		
		6010/6099		

Account.	Description.	Cost Heads.	Details.	Further Details.
61	**SALARIES AND WAGES OF METER-READERS, Etc.**	6101	Salaries.	
		6102	Wages and Overtime.	
		6103	Caps.	
		6104	Matches.	
		6105	Candles.	
		6106	Spot Lights.	
		6107		
		6108		
		6109		
		6110		
		6111		
		6112		
		6113		
		6114		
		6115		
		6116/6199		
62	**REPAIRS AND MAINTENANCE OF DISTRICT GASHOLDER STATIONS AND GOVERNORS, including H.P. ENGINE.**	6201	Repairs and Maintenance of District Gasholder Stations and Governors.	
		6202	Heating, Cleaning, Repairs, Alterations, Jobbing at Offices.	
		6203	Engine for H.P.	Repairs and Maintenance.
		6204	Coke.	
		6205		
		6206		
		6207		
		6208		
		6209		
		6210/6299		
63	**REPAIRS, MAINTENANCE, and RENEWAL OF MAINS AND SERVICE PIPES.**	6301	Repair or Alter Mains.	
		6302	Escapes—Mains.	
		6303	New Service Pipes.	
		6304	Repair, Alter or Remove Service Pipes.	Includes Screwing Pipes in Workshop.
		6305	Renewing old Service Pipes.	
		6306		
		6307		
		6308	Deficiencies—Service Pipes.	
		6309	Escapes—Service Pipes.	
		6310	Plug old Service Pipes (supply permanently discontinued).	
		6311	Barricade Lamps.	
		6312	Escapes, Deficiencies and Prove House Fittings.	
		6313	New Entrance Pipes, over 5 feet.	
		6314		
		6315		
		6316		
		6317		
		6318	General Purposes A/c. Mains.	
		6319	Camp Allowances.	
		6320	Waiting Time.	
		6321	Travelling Time.	
		6322	Coke.	
		6323		
		6324		
		6325		
		6326		
		6327		
		6328/6399		

APPENDIX No. 15

Extract from Industrial Welfare and Personnel Management.

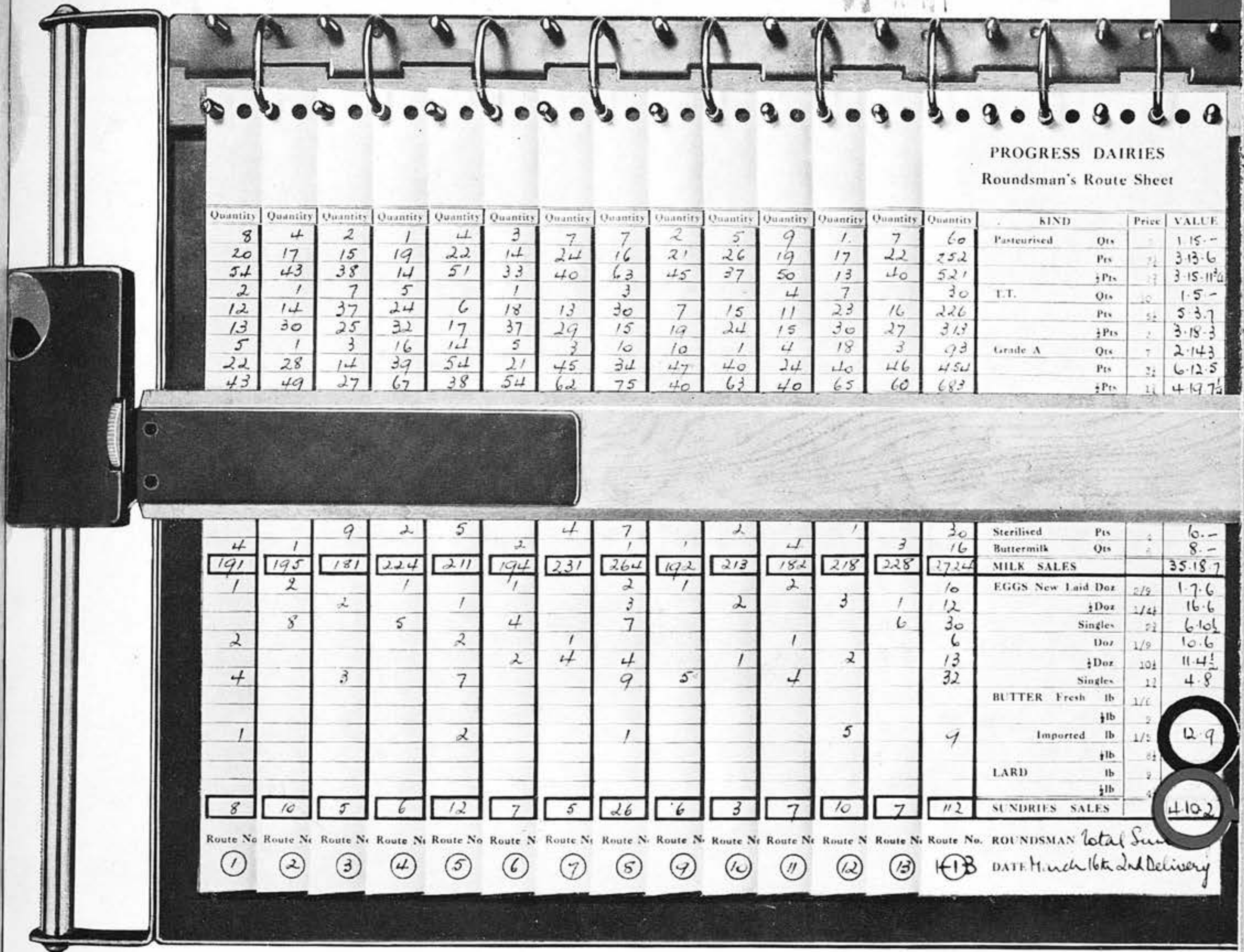
Values of Illumination in Factories

The Illuminating Engineering Society has prepared through one of its technical sub-committees a table of recommended values of illumination for different types of work in industry. The foot-candle values given are service values, and it should be remembered that after installation some depreciation takes place. They are calculated on the basis that at no point in the working area shall illumination fall below 70% of the maximum.

	Foot-candle values.	Class of Task
1.	Above 50	Precision work to a high degree of accuracy: tasks requiring rapid discrimination and response, displays.
2.	25 - 50	Severe and prolonged visual tasks, such as fine engraving, sewing of dark goods, inspection of fine details of low contrast.
3.	15 - 25	Prolonged critical visual tasks such as proof reading, type setting, drawing, reading, fine machine work, fine assembling, sewing on dark goods, large stores.
4.	8 - 15	Visual tasks such as detailed office work, skilled bench work, sewing on light goods, retail stores.

5. /

Appendix 16.



PEEDY CONSOLIDATION OF ALL DISTRIBUTION, ANALYSIS AND STATISTICAL REPORTS

Distribution, analysis, and statistical reports are eedily consolidated on the summary board for illing with a Burroughs Electric Duplex Adding-culator.

This method of assembling figures has several portant advantages:

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SIMPLER — Eliminates repeated handling of forms.

MORE ACCURATE — Once the figures are correctly ssified on the strip forms, it is impossible to classify em incorrectly in summarizing.

MORE ECONOMICAL — Special machines and borate distribution equipment are unnecessary.

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The summary board is used in preparing summaries or distribution of sales (or cost of sales) by commodities, departments or territories; earnings records and payroll distributions by departments or branches; shipments and inventories of stock; forecasts of production requirements; analyses of production and similar applications.

A careful analysis of your particular problem will be made without obligation. Telephone the nearest Burroughs office today — or send the enclosed postcard.

Motion Study in Typewriting,
by J. M. Lahy.

Appendix No. 17

Technical Progress and Scientific Method.

The efforts which men have made throughout the centuries to perfect the technique of the ancient trades almost pass the imagination. Innumerable blind attempts, experience lost and regained, sage observations forgotten and repeatedly revived, have gone to build up the tradition of the carpenter's or blacksmith's movements, and make of it a rule of work which is religiously handed on from master to apprentice.

* * * * * *

The primitive beliefs of the first artisans have given its strength to the tradition which compels a young worker to adopt the movements evolved by age-long experience.

Excellent though the final results of such methods may be, it is inconceivable that they should be applied to the many new callings which have appeared in modern society. Nevertheless one of the newest occupations, that of typewriting, followed this outworn method until psycho-physiology took its rightful place in the sphere of human labour and offered, in place of the primitive rule of thumb, a technique based on scientific study of the movements required for the typewriter. This is as yet still a recent development, as to the writer's knowledge his are the first experimental investigations undertaken.

Although typewriting is barely forty years old, it has no /

18 20 21 22

no rules of work except those due to haphazard individual discoveries, sometimes handed on, more often lost, and in no case absolutely valid, as they were not based on scientific investigations. The keyboard, for instance, was invented in America for purposes of correspondence in the English language; the letters are grouped, according to the frequency with which they occur, on those portions of the keyboard which seem easiest to reach. The frequency with which letters occur varies, however, in different languages; and thus English-speaking typists are exceptionally favoured in comparison with their colleagues in other parts of the world.

But there is a still more striking fact to be noted: as the letters were arranged solely according to their frequency of occurrence, no attempt was made to determine their relation to the ease or otherwise of different finger movements. No one tried to discover the easiest combination of movements in order to use them for the combinations of letters which occur most frequently. This study will show that the so-called "universal keyboard" is not really the best, even for Americans who gave it to the world.

* * * * * *

Readers of this study should certainly be convinced that bythe adoption of scientific methods humanity could gain years and even centuries in establishing the best rules for executing occupational /

18

occupational work.

* * * * * *

This test sentence (We are in receipt of your letter) was chosen in order to obviate any mental effort, and in fact none of the subjects paid any attention to his movements. Most of them replied, when questioned concerning the test: "My fingers hit the keys of their own accord", and they all stated that they typed it absolutely mechanically. Some even said that they "thought on the machine", presumably meaning that their mental images were exclusively those of typing movements and not those of handwriting.

* * * * * *

This method constitutes the first attempt at adapting the data of experimental science to professional technique. It will mark an epoch in the history of modern methods of training, as it shows, supported by practical results, what can be achieved by co-operation between laboratory and workshop.

* * * * * *

Results

It can simply be stated that speed in typewriting is mainly achieved by shortening the intervals; shortness of contacts would seem to be an effect rather than a cause of speed.

The third factor in touch, namely, the force used in striking a key, is also related to the period of the contacts and /

and intervals.

Alternation of the hands immediately reduces all the factors in movement: period of contact, intervals, and strength of touch. This is best shown by pneumatic recording machines.

* * * * * *

It is unnecessary here to pass any final judgment on the ten-finger method, which is based on a false analogy between the typewriter and the piano, but it may be noted that the majority of typewriting pupils practise for months and years in order to achieve difficult feats, for which they have no aptitude, simply because this method has become orthodox.

Moreover, the same fate befalls typewriting methods as any other form of constraint on the working of the human organism imposed either by prejudice or in the name of some half-science: physiology always reasserts its rights.

* * * * * *

The human organism tends to free itself from external constraint; defective training alône does not account for the fact that the majority of typists taught on the ten-finger system later automatically take to using six, four, or even two fingers, as best suits their own organism. This was attributed to deliberate slackness on their part, and pupils were still compelled painfully to learn the orthodox system of fingering. Yet it would have been easy to make the simple experiment /

experiment of tapping rapidly with one hand or the other, and then with the two hands alternately; this would have shown that much greater speed was attained when the hands were alternated.

* * * * * *

Without embarking on investigations or explanations in pure physiology, one is led to enquire what mechanism determines the limit of typewriting speed.

The nervous and muscular factors involved when two successive strokes are performed with the same hand are probably the same in each movement. As these movements are very rapid, not exceeding a few hundredths of a second, the internal changes in the tissues which determine these movements occur during the periods of inertia in each movement of the hands when used alternately.

All movements, however simple, are the result of a chemical process inside the nerve cells, to mention these only. When a cell functions it expends part of its reserves, and simultaneously a process of assimilation takes place to reconstitute these reserves. There is an incessant interchange of nutritive products and waste products; this is indicated by a substance called chromophil found in the interstices of the network formed by the cytoplasm of the nerve cell. When the balance of nutrition is disturbed, this substance disappears progressively, beginning /

beginning at the nucleus, which itself moves from the centre of the cell towards its circumference, while the cell diminishes in volume.

While the balance of nutrition in the cell is destroyed by excessive activity, the destruction of this minute organism is hastened by another phenomenon. The waste products, the residue of the chemical process which have taken place, are not eliminated sufficiently quickly and paralyse the cell's action like a poison.

These two causes together will stop the action of a cell if there is not a sufficient interval between two successive stimuli or two reactions. There are several proofs of this. When the brain cells of a dog which has been trepanned are stimulated electrically, the motor reactions to this stimulus are only obtained if there is an interval of at least one-tenth of a second between each stimulation; the refractory period in animals is thus one-tenth of a second. The same is true of human beings. The special cells forming the retina under the action of light waves undergo a chemical process which produces visual sensation. If the successive sensations are to amalgamate, the intermittent stimulations causing them must strike the retina at intervals of less than onetenth of a second. If the intervals are greater, the sensory cells start a new process and separate instead of fusing the successive images, for as each refractory period ends a new image is distinguished.

As /

As is well known, if a subject wishes to produce a series of voluntary muscular reactions, the maximum number is nine or ten per second for the most gifted persons under the most favourable conditions. But this limit is not the same in reactions produced by exciting the muscle electrically without recourse to the nervous system; in this case 40 separate shocks per second can be produced. The refractory period of the nervous cells is thus approximately one-tenth of a second, which means that if two stimuli are applied to one of these cells within a shorter period, the same phenomenon will occur as in the fusion of luminous impressions: the cell will not react to the second stimulation.

Two things must at once be noted without which it would be impossible to explain individual differences in typewriting speed. In the first place, the figure of one-tenth of a second is not strictly accurate; there are probably individual variations which, though slight, are nevertheless characteristic. Secondly - and this is important - the movements of the various parts of the hand used to strike the keys involve more than one cell. It is probable that groups of cells fulfil this function, and though they act almost together substitutions may be effected and increase the muscular action of the hand. Moreover, though the same hand may be used for striking, the same finger is not always used. The reciprocal action of adjacent cells in the same area of the nervous system is not known in detail, but/

but it may legitimately be supposed that the use of different fingers involves different though adjacent cells.

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There is too often a tendency to explain apparently simple physiological phenomena by facts which themselves are too simple. It is my aim to avoid this mistake. To attribute the superiority of certain typists over others entirely to the rapidity of their nervous processes is, I am well aware, an easy solution. I have pointed out elsewhere that memory, spelling, and various other mental functions are factors of superiority which, combined in varying degrees in different typists, lead to superior efficiency. But apart from the fact that such functions are very different from the motor functions just discussed, they do not in themselves explain why highly skilled operators are not exactly the same in their exercise of the profession.

* * * * * *

There thus appear to be two kinds of movements, the efficiency of which varies. Hand movements are quicker and more skilful with the right hand than with the left; finger movements are simpler and quicker for the left hand than the right. These facts are confirmed by the prevailing practice. Typists questioned on this point agreed that it was earier to strike keys in the left half of the keyboard with the right hand than to strike a key in the right half of the keyboard with the left hand. The following rule may be deduced from these /

these observations: with existing keyboards alternation of the fingers of the left hand and "jumping" the fingers of the right promote speed.

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In typewriting with a good rhythm, the intervals should be as nearly equal as possible; the rhythm would be further improved if the period of contacts were also equal.

* * * * * *

In ordinary typing, speed is the main object; the typist makes the slight movements required in the minimum time necessary for repairing the wastage of the tissues where the changes on which the movements depend occur, as explained on an earlier page. In cutting stencils the typist directs his attention to each of his movements, watching them and regulating their force as he does not in ordinary typing. Part of his available energy is thus deflected by this additional effort. His movements are less automatic, every part of them is consciously observed, and they are harmonised in the simplest possible manner, by equalising their values.

<u>The Teaching of Typewriting.</u>

On the contrary, data of this kind should strengthen our convictions, as they confirm the common impression of the extreme diversity of human types. The conclusion to be drawn is that, though there are a few absolute rules which are of use in /

in occupational work, there are many which can only be applied after more or less exhaustive examination of the subject - the typewriting pupil in this instance.

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A fundamental law, which is so general that it should govern improvements both in typewriting machines and in typewriting method, is the law of alternation of the hands. Both makers of typewriters and typewriting experts should endeavour to make alternation of the hands as frequent as possible. This law, it should be emphasised, is based, not on an individual opinion or on any technical necessity in the construction of typewriters, but on the working of the human organism.

It cannot be ignored that, even though every attempt to improve typing technique should tend towards alternation of the hands, such efforts are necessarily limited. However the letters and signs are arranged on the keyboard of a typewriter, successive letters in any given word cannot always alternate, since the keyboard is fixed. No system of typing can secure perfect alternation of the hands. Consequently the fingers of the same hand must be employed successively.

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The second fundamental rule of typing touch may therefore be stated as follows: alternation of the fingers of the left hand and "jumping" with those of the right promote speed.

The /

The keyboards at present in use have been arranged on the basis of statistics as to the frequency with which letters occur in the words most used, the letters struck most frequently being placed in the most accessible parts of the keyboard. This principle is erroneous. The rule of alternation of the hands proves that the statistics used should be those of the letters most frequently alternated and that these letters should then be placed in opposite parts of the keyboard.

The space bar should no longer be regarded as a purely accessory appliance, placed outside the keyboard because it works neither a letter nor a sign. On the contrary, it should be treated as an essential part of the keyboard; it should be included in statistics of the frequency of alternation and placed in the keyboard accordingly.

The rectangular form of the keyboard also requires investigation. It might be advisable to make it in the form of a curve, more adapted to the fan-like arrangement of the fingers. Graphic analysis of the movements involved in typing would make a valuable contribution to the solution of the problem.

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It is a curious fact that one of these, the ten-finger method is based on erroneous observations, and yet enjoys the greatest popularity and is the most frequently taught in typewriting schools.

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The /

The impossibility of establishing a rigid method applicable to all typists has led to the general conclusion that typewriting touch is a personal matter, just like ordinary handwriting. There are very few people whose handwriting is the same; similarly typists are not built on identical lines, and cannot therefore produce identical results with the same methods.

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The adoption of one or other method for teaching typewriting should depend on many factors. One of these is the anatomical structure of the hands and fingers (the ten-finger method presumably requires a large hand); the functional independence of the muscle groups which determine the agility of the fingers is also an important factor. But the essential factor in vocational characteristics, in my opinion, is to be sought in the more delicate anatomy, in the nervous system which determines motor rapidity.

Fatigue and Boredom in Repetitive Work, By S. Wyatt and J. N. Langdon (Assisted by F.G.L. Stock).

APPENDIX No. 18

Preface.

Continued study of repetition work in industry is justified by the increasing number and variety of repetitive processes, and by the importance of the human problems associated with this type of work. The repeated performance of simple and uniform movements provides small opportunity for the exercise of thought and skill, and imposes restrictions on personal abilities and desires which favour the onset of boredom; it may have effects which extend even beyond the period of work.

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Much is now known regarding the nature of boredom and its relation to personal characteristics and to conditions of work; and this knowledge is available as an aid in selecting individuals who are most suitably qualified for repetition work, and in the arrangement of working conditions so that boredom is less likely to arise. The possibilities of applying knowledge in this direction are discussed in the report.

Introduction.

The general aim of this inquiry was to collect information on the nature, causes and prevalence of boredom and discontent among operatives employed on simple types of repetition work.

Since /

Since boredom and discontent are personal experiences which cannot be directly observed or measured, evidence of their existence must depend primarily on introspective data. To obtain such data it is necessary to induce individuals to describe their thoughts and feelings, either in the form of a free expression of opinion or in response to questions. In this inquiry both methods were used, and the one served to check or amplify the other.

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The procedure admittedly has certain limitations since the assessments depend on the reliability of the views expressed by the workers and on the judgment of the investigator. To minimise these weaknesses the same question was often repeated in a different form and the assessment was based on the independent opinion of two investigators. A certain amount of objective corroboration was also obtained from detailed records of the rate of working throughout the day.

Since susceptibility to boredom is partly dependent on personal characteristics and tendencies, the study of individual differences and their relation to the amount of boredom experienced becomes a matter of practical importance.

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In industry one wants to know whether proneness to boredom is specific or general. It may happen that some individuals are bored by one type of repetition work but not by another. On /

On the other hand, boredom may be experienced whatever the type of work. Several of the operatives included in the present inquiry had been employed on different processes in the same factory, and their views provided a certain amount of information on the general or specific nature of boredom. The question was also studied experimentally in a small group of workers who were employed for monthly periods on five different types of repetition work.

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All the subjects were experienced female workers, and co-operation in the experiment was voluntary.

Results Obtained.

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The preceding results show that an individual may be bored by the particular type of repetition work on which she happens to be employed. The question arises as to whether this individual would be equally bored by other types of repetition work, i.e., whether boredom is specific or general.

The theoretical and practical aspects of this question are important and are closely connected with the principles and practice of vocational guidance. If, for instance, the experience of boredom is general so that an individual is likely to be bored by all kinds of repetition work, then the process of guidance becomes correspondingly simplified. If, on the other hand, a worker is bored by one type of repetition work but /

but not by another, it is important to determine the particular kind of work which is likely to provide the greatest degree of interest and satisfaction.

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Personal Characteristics and Boredom

Any large and unselected group of workers employed on the same type of repetition work will contain some individuals who are bored by the process and others who find the work comparatively interesting. Thus the amount of boredom experienced is also dependent on personal factors, and the discovery of these is clearly a matter of some importance.

The problem may be approached by considering some of the clues which have emerged during this and previous investigations on the same subject.

In the first place there is much evidence in favour of the view that susceptibility to boredom is related to intelligence.

Secondly, individuals differ in their ability to mechanise work, and there is reason to believe that boredom may be most pronounced in those persons who are unable to detach their thoughts from uninteresting work.

Thirdly, some people find it difficult to switch from one type of activity to another. The ideas and movements set in motion by the repeated performance of the first process tend to /

to persist and to interfere with the activities of the second process. Others seem to be practically free from this kind of interference, and it is possible that proneness to boredom may be related to the one or the other of these tendencies. The spontaneous recurrence of past experiences is usually known as perseveration.

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When questioning the workers it became increasingly apparent that some individuals preferred simple forms of repetition work involving a minimum of attention and thought while others expressed a desire for processes which required initiative and creative ability.

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Boredom and Gramophone Music

Althought individuals employed on repetition work indulge in day-dreaming, talking, singing, and the like, their efficacy as antidotes to boredom is often limited.

Day-dreaming, for instance, is possible only when the work is simple, uniform, and free from interruptions. Although many industrial processes are of this type, others make varied and intermittent demands upon attention and judgment, and to this extent they interfere with mind-wandering. Even when uninterrupted day-dreaming is possible, there is a growing belief that prolonged indulgence in flights of fancy may be undesirable or even harmful.

As /

As regards talking, the possibilities in this direction are obviously dependent on the proximity of other workers, but in most factories two or more workers are usually within talking distance of each other. At the same time there is little doubt that talking, although an effective antidote to boredom, is by no means the ideal remedy. As a rule a certain amount of visual attention is required for the successful performance of the industrial task and anything which causes the operative to look in other directions will have an adverse effect on the speed and accuracy of production. Most workers when talking are affected in this way and output suffers accordingly. This does not mean that talking should be forbidden, as such a procedure would be conducive to boredom and the resulting output would probably be lower than before. It merely indicates that, from the standpoint of production, talking has certain disadvantages.

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Since boredom is due to an awareness of the monotonous conditions of work, its alleviation will depend upon the extent to which the mind can be distracted from these conditions.

ATTITUDE TOWARDS WORK

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It is, for instance, useful to know the relative importance assigned by workers to such questions as opportunity for /

for promotion, security of employment, high wages, and the like. Knowledge of the workers' opinions on these matters and the extent to which their desires are likely to be satisfied by existing conditions of work will show the more important sources of dissatisfaction and should direct attention to the possibilities of their removal.

In addition to the attitude towards the more remote and sometimes intangible factors which form the background to industrial activity, it is also important to know the view of the operatives on those features of their working environment which impinge more directly on thought and work. These include physical factors such as noise and temperature; material conditions such as waiting for work and trouble with the machine; and personal relationships such as working companions and the type of supervisor. Likes and dislikes induced by the more concrete and immediate elements in the working environment are sometimes very intense, yet their existence and importance are often overlooked or ignored.

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Relative /

Relative importance of factors associated with
the conditions of work.

Order of
Importance

1. Security of employment.
2. Comfortable working conditions.
3. Pleasant working companions.
4. Good supervisor.
5. Opportunity for promotion.
6. High wages.
7. Short hours.
8. Opportunity to use your own ideas.
9. Work which makes you think.
10. Work which needs no thought.

Most importance was attached to security of employment, which received between 80 and 90 per cent. of the possible number of votes. As this factor is closely connected with fundamental desires, its dominant position in the list is not surprising. The next in order of preference were comfortable working conditions, pleasant working companions, and a good supervisor. These three factors received roughly the same number of votes and they are obviously closely related to the comfort and contentment of the operatives while at work. They represent the personal and material factors in the immediate environment of the operative, and anyone familiar with working conditions will appreciate their value as determinants of pleasure in work. The desire for promotion occupied an intermediate position in the list, and this was closely followed by the interest in high wages. The relatively low position of the latter factor was somewhat unexpected as wages are usually believed /

believed to occupy a focal position in the thoughts of the workers. Finally, the operatives were not unduly perturbed about the amount of thought required by work or opportunities to use their own ideas. Whether work required much or little thought seemed to be relatively unimportant compared with the other items on the list.

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It is often believed that industrial workers attach more importance to wages than to any other factor associated with the conditions of work. The results of this limited inquiry fail to support this belief and show that, within the range of items included in the list, wages were ranked sixth in order of importance and were regarded as less important than pleasant working companions and comfortable conditions of work.

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Some additional information on the subject of posture was obtained from the replies to the question "Which do you prefer (a) to stand while working, (b) to sit while working, or (c) to stand and sit alternately?" This question was given to the workers in Factories B and C and the preferences, expressed as a percentage of the number of individuals in each group, were as follows:-

	Factory B.	Factory C.
Stand all day	18	11
Sit all day	-	-
Stand and sit alternately	82	89

Thus /

Thus a large majority preferred to stand and sit alternately and the remainder preferred to stand. It should be mentioned that most of these operatives had to stand while working, and it is probable that a different distribution of replies would have been obtained from workers who had to sit all day. The results nevertheless express a felt need, and although it is often impracticable to arrange for operatives to stand and sit alternately, there is scope for improvement in this direction.

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It seems probable, therefore, that an intermittent and variable noise which is heard against a background of comparative silence is more noticeable and disturbing than a louder but more continuous noise. Apparently the workers tend to become adapted to a noise which is loud and continuous, but continue to be disturbed by a weaker and irregular noise.

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There is little doubt that boredom increase sensitivity to distracting stimuli, so that workers who are bored are more likely to be aware of and irritated by extraneous noises than those who are interested in their work.

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Clearly, therefore, the same noise may be disturbing to some individuals and not to others. There is some evidence that personal susceptibility to noise is associated with the presence /

presence of nervous symptoms, and this may account for some of the differences observed in the present investigation. The reaction to noise, however, is obviously the resultant of many different factors, and their complete analysis still awaits investigation.

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Thus an average increase in temperature from 68.0°F. to 80.2°F. caused a corresponding decrease in output of 11.7 per cent. As might be expected, the difference in output on the days of high and moderate temperature became more marked as work proceeded throughout the day.

Considerable reductions in output were also recorded in one of the operations in Factory B when the temperature was unusually low. During a period of three weeks, when the average temperature was 52.3°F., the output was 21.4 per cent. lower than that recorded during the preceding and following period when the average temperature was 59.1°F.

Thus both high and low temperatures are unfavourable to output in simple forms of repetition work, and it is not surprising that numerous complaints were received from the workers exposed to such conditions.

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Boredom and Individual Preferences

The results show that the bored workers attached relatively more importance to opportunities for promotion, to opportunities /

opportunities to use their own ideas, and to work which makes them think, but less importance to work which needs no thought. In other words, they felt more strongly the urge to forge ahead and the need of food for thought. Conversely, the individuals who were most satisfied with simple forms of repetition work were those who lacked ambition and were mentally lazy or dull.

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Boredom and Dissatisfaction

The results show that the frequency of complaints received from the bored workers was greater than the number made by the least bored members in each group. In particular, the bored workers complained more frequently about the lack of opportunities for promotion, monotony of work, fatigue, severity of work, and the small amount of thought required by work. A higher proportion of the bored group also tended to find fault with noise and with the material used in the industrial process. Thus boredom increases sensitivity to certain features associated with the type and conditions of work and consequently is an important factor in the promotion of dissatisfaction and unrest.

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DISCUSSION OF RESULTS

The general impression formed as the result of this inquiry is that repetition work contains little that is inherently /

inherently interesting or satisfying. Boredom and dissatisfaction were fairly common and there was often an appreciable gap between personal desires and their satisfaction in work. This is probably not surprising since interest in work depends fundamentally upon its ability to satisfy instinctive tendencies or some acquired disposition based upon these tendencies, and repetition work is a somewhat barren field for this purpose. It is only a means to a number of ends, and, unlike the activities of the skilled craftsman or scientist, is seldom an end itself.

Activities which are intrinsically distasteful may, of course, become comparatively pleasant when linked with a personal need. All industrial work possesses thks feature since it provides the money for the necessities and some of the luxuries of life. The fact remains, however, that repetition work as a whole fails to arouse interest and hold attention, so that thoughts are often directed to the distasteful aspects of work.

This connection between thought and work provides a clue to the nature and causes of boredom. Thus boredom arises when the mental processes involved in work fail to occupy and to hold the focus of attention. If the mind is unable to find an effectige substitute it tends to be directed to the unsatisfying features of work and the individual becomes bored. This experience, which is mental in origin, naturally induces an /

an unpleasant emotional state or mood, and results in a heightened sensitivity to unfavourable elements associated with the conditions of work. Minor disturbances and distractions which would pass unnoticed by the interested worker become exaggerated and intensify still further the emotional background of discontent. One of the most important of the human problems in industry is the possibility of diverting attention from the monotony of work, and although the operatives adopt many devices for this purpose, they receive little assistance from those who are responsible for working conditions.

The experience of boredom is dependent on many factors, which may be either subjective or objective. It is, in the first place, closely related to personal characteristics and tendencies, since some individuals may be bored by a process which is interesting to others. The discovery of the particular characteristics which make the individual susceptible to boredom is accordingly a matter of some importance and is a necessary prelude to vocational guidance.

The results of this and of previous investigations show that some individuals prefer work which needs no thought or responsibility, and that these individuals are usually below the average in intelligence. Conversely, severe boredom is usually below the average in intelligence. Conversely, severe /

severe boredom is usually found associated with more than average intelligence. At the same time there is reason to believe that the relation between boredom and intelligence may be due partly to the fact that the more intelligent tend to have an educational and social history which leads them to consider themselves "too good for the job". There are also indications that a similar attitude may be produced by continued education, especially when combined with superior social status, in the absence of any marked degree of intelligence. It seems highly probable, therefore, that boredom is most likely to arise when superior intelligence is associated with a superior attitude towards the type and conditions of work. There is not the least doubt that large numbers of industrial operatives possess more intelligence than is necessary for the work. The numbers required for low-grade repetition work will also probably further outstrip the supply. This makes it all the more necessary to consider the possibilities of neutralising boredom by the creation of additional interests during work and the development of compensating activities ourside work.

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The boredom experienced by the individual who is unable to detach the mind from work will depend upon the completeness of this process. If her capacity for mental detachment is slight so that work occupies the focus of attention, then boredom is not likely to arise. If, however, the work makes only partial /

partial or intermittent demands on attention so that it interferes with continuous thought, the experience of boredom may be sever. Thus individual differences in the ability to mechanise work help to account for the varying degrees of boredom experienced by workers on the same process.

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Finally, some individuals seem to have strong constructive tendencies while others are content to repeat the same simple cycle of movements. The majority, however, fall within the former category and drift into repetition work because no other type is available. If they were free to choose there is not the least doubt that repetition work would have few adherents; consequently it is most important that it should be made as attractive as possible.

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The introduction of suitable rests and the provision of refreshments are frequently regarded as attempts to pamper the workers. On the contrary they cater for definite psychological and physiological needs and provide an economic method of combating the effects of exposure to long periods of uninteresting work.

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Although it is improbable that the inferior surroundings were the primary cause of boredom and discontent, they undcubtedly /

undoubtedly intensified existing tendencies. Conversely, it can be stated with assurance that bright and attractive surroundings help to check the onset of boredom and to reduce its effects. They do so by providing a useful form of distraction for roving thoughts and by inducing a cheerful mood which makes it more difficult for boredom to find a place. There can be little doubt that the modern factory, with windows instead of walls, a spacious interior, and pleasant colour schemes, has psychological effects which are by no means negligible. The subtle but important influence of light and colour upon disposition and mood have long been recognised, but the measurement of their effects still awaits investigation.

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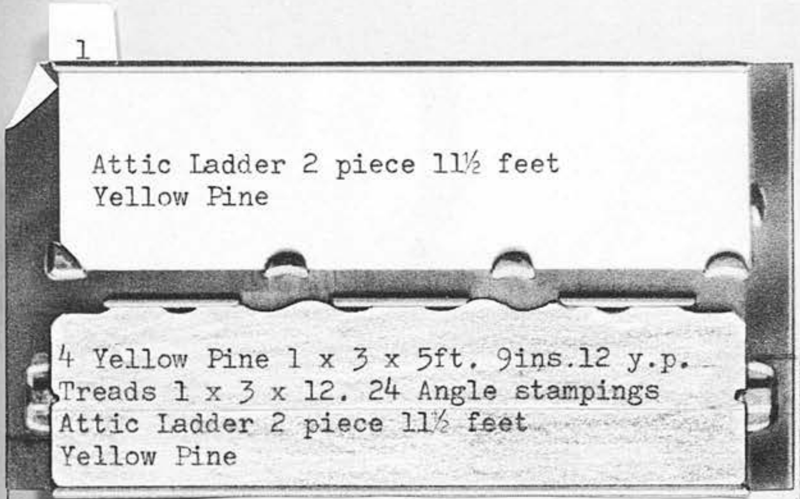
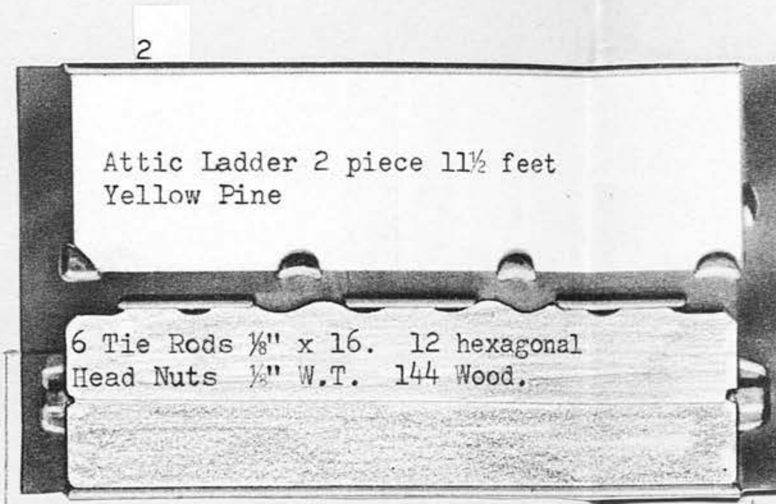
Whatever methods may be adopted for the purpose of alleviating boredom, it must be recognised that, for many individuals, a certain amount of boredom is an inescapable condition of modern factory life. Probably the most hopeful outlook lies in the direction of an improved social system which would compensate for its endurance by shorter working hours combined with greater opportunities for self-expression in the form of cultural and recreational pursuits. At the same time it must be remembered that many individuals tend to become adapted to monotonous conditions of work. Thus several of the workers, when questioned on their feelings and attitudes stated that they had ceased to think about such matters and accepted /

accepted them as a customary feature of their daily life.
A common type of remark was:-

> "I have done this all my life and I shouldn't like to do anything else now. I used to feel that I should like another job, but this one seems to have got me and I am quite content."

This philosophical resignation to prevailing conditions which seems to be a characteristic of advancing age is probably accelerated by the dulling effects of monotonous work. It is a form of adaptation which prevents conflict and promotes a peaceful frame of mind. How far it is desirable is, of course, another question.





M A T E R I A L   I S S U E D .

NAME OF ARTICLE.	MATERIAL AUTHORISED & BIN NO.'S.
Attic Ladder 2 piece 11½ feet Yellow Pine	4 Yellow Pine 1 x 3 x 5ft. 9ins.12 y.p. Treads 1 x 3 x 12. 24 Angle stampings 6 Tie Rods ⅛" x 16. 12 hexagonal Head Nuts ⅛" W.T. 144 Wood. Screws, Round Head ⅜". Bin Nos.6,14,48,90,90a,185,190.

APPENDIX No. 22.

Scope for Application of Multiple Head Addressing Machinery.

This appendix is intended to indicate purposes where two or more different parts of each plate are utilised at one run for different columns of a single form, through the alternating use of different cut out pads in each head of the addressing machine.

Preparation of:-

1. Rating and valuation lists for local authorities (e.g. address in one column and nature of premises in another).

2. Account sheets for public utility companies (e.g. name in one column, address in another).

3. Agents debit lists for insurance companies (name in one column, address in another, premium in another).

4. Rent collection sheets for factors. Name / address / rent.

5. Wages sheets. - Name / classification / insurance deductions.

6. Dividend lists. Name / address / details of stock.

7. Insurance notices, agents' slips receipt.

8. Dividend warrants, Income Tax certificate.

9. Factory and other forms where different parts of plate information is required in different positions on form.

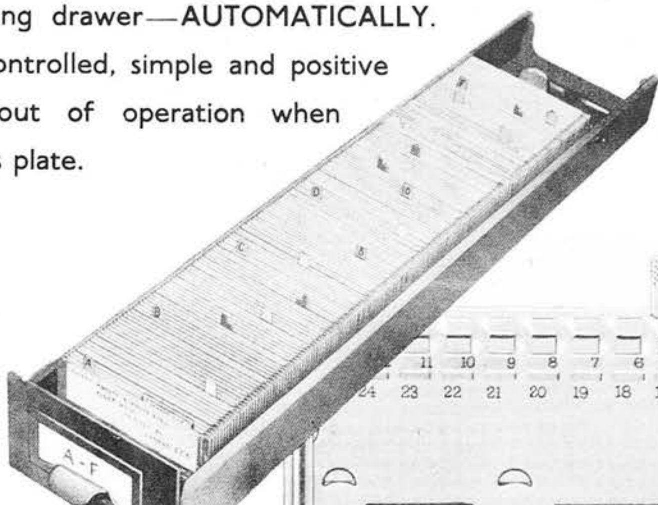
THE *Addressograph* AUTOMATIC SELECTOR

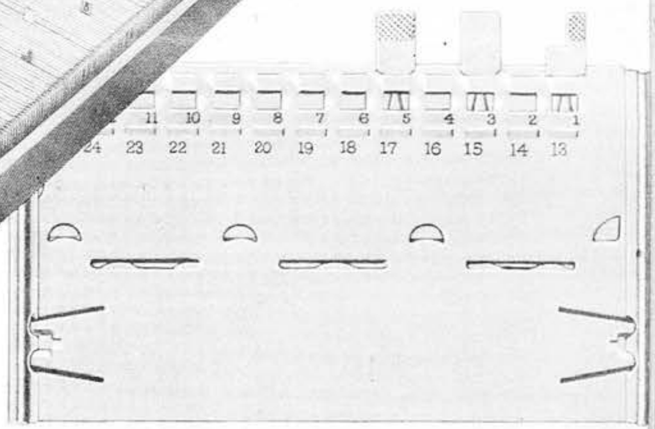
Appendix 23

The automatic Selector obviates the need for separate lists; makes possible the automatic selection of any classification or group of classifications within one centralised list.

The Selector automatically selects certain address plates to "print" or "skip" as desired. Plates after printing or "skipping" are refiled in original order—in original filing drawer—AUTOMATICALLY.

The Selector is mechanically controlled, simple and positive in action: quickly thrown out of operation when requiring to print every address plate.





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2

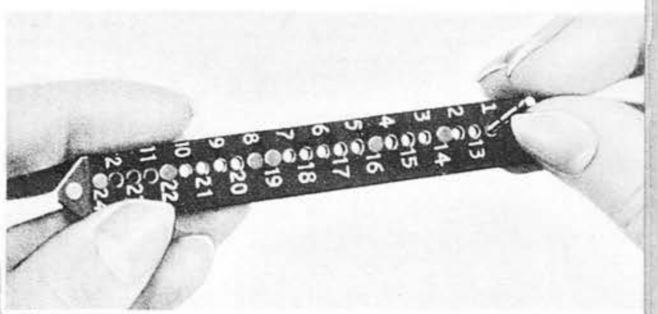
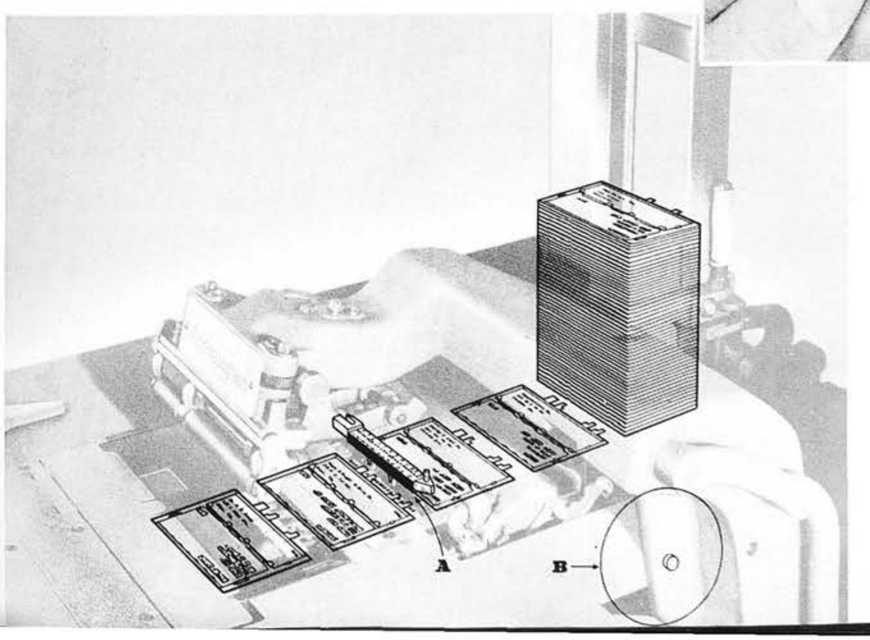


Illustration (1) "Addressograph" plate with removable tabs: plate has 12 sockets which accommodate—plain, coloured, numerical or geographical metal tabs. Tabs indicate different classifications, i.e. sex, rating, territory, products etc. Full-faced tabs permit 12 different classifications; notched (half faced) tabs provide 24, whilst two or more tabs in combination permit almost limitless number of classifications.

Illustration (2) Selector Bar—Note holes corresponding to 24 tabbing positions on plate. For selection of any particular classification or group of plates, Selector Pins are placed in holes corresponding with tabs in plates. When pin contacts tab, machine "prints" or "skips" according to predetermined setting of Selector device.



SELECTOR BAR:

Figure A shows control pins in the Selector Bar corresponding with tabs on the plates.

BELL SIGNAL:

Figure B shows Bell Signal—which is operated by the Selector Mechanism, and indicates special circumstances to operator, i.e. when duplicate prints are required, etc.

ADDRESSOGRAPH = MULTIGRAPH LIMITED

"Business Enterprise",
October 1938.

APPENDIX No. 24

NEW INDUSTRIES for SCOTLAND

Reasons for the Location of the New Factories.

	1933	1934	1935	1936	1937	Total	Per cent.
(a) Accessibility of Raw Materials	35	33	38	27	26	159	9
(b) Proximity to Markets . .	35	27	28	24	34	148	8.5
(c) Suitability of Labour . .	23	18	37	56	67	201	11.5
(d) Cheap Land, Low Rent or Rates	14	17	20	23	34	108	6
(e) Proximity to other Factories in same industry . .	65	33	26	38	41	203	11.5
(f) Convenience of Premises . .	90	163	208	224	212	897	51.0
(g) Proximity to Employer's Residence . . .	17	4	8	13	2	44	2.5
	279	295	365	405	416	1,760	100.0

Note the importance of convenience of premises

The Use of Performance Tests of Intelligence in Vocational Guidance

Meaning of the Term "Performance Test".

A "test" is usually understood to mean a trial of strength, knowledge, skill or ability, and a person's capacity is very frequently judged by the amount of knowledge he possesses or by the degree of skill he displays in some activity or process in which such skill is conveniently expressed.

* * * * *

Tests may be of various kinds according to the material they employ or according to their purpose; thus, for example, scholastic tests aim at measuring attainment in school subjects, intelligence tests seek to gauge general educable capacity, while trade tests are usually designed to show the extent of a person's mastery of some particular trade or occupation. But within recent years attempts have been made to distinguish between -

(i) tests which give evidence of inborn or innate ability, and

(ii) tests which measure the extent to which some particular knowledge or skill has been acquired, without endeavouring to disentangle the diverse influences of innate ability, instruction, practice and the like.

Of course, since native ability affects all our learning, this distinction is a difficult matter and a special technique of /

of examination is necessary in order to secure it. Tests devised for this purpose have been called "psychological tests" because they are based upon a careful analysis of the psychological processes which underlie the activities in question.

* * * * *

The Need for Performance Tests in Vocational Guidance.

As is generally known, the first systematic scale of tests of intelligence was that devised by Biset. Many of these tests require considerable skill in the use of language and in the interpretation of abstract ideas, but there are also included a number of practical problems (such as the "Three commissions", "discrimination of weights", and "memory for designs") which are performance tests in the sense described above. As, however, they are relatively few in number, it has been customary to regard the Biset scale (and its variants) as predominantly verbal, and its results as dependent on the ability to understand and to use language.

For this reason performance tests of intelligence have been described as "non-verbal", even though the instructions be given through the medium of language.

* * * * *

The Use of Performance Tests of Intelligence in Vocational Guidance.

The satisfactory use of performance tests of intelligence in vocational guidance depends upon the purposes they are intended to /

to serve. As measures of intelligence at school leaving age it appears from the results obtained in our enquiry that they are of limited value. But the specific abilities which enter into success in them may have vocational significance. To determine the extent to which this is the case it is necessary to compare the success of a person in the tests with his efficiency in some occupation in which the same or similar abilities are needed.

Up to the present there have been very few occupational studies in which performance tests have been used.

* * * * *

Classification of Occupations.

The foregoing results also have a direct bearing on a classification of occupations which has found many supporters. Three groups have been distinguished, based on the nature of the work to be done, viz., work dealing chiefly with inanimate objects, work dealing chiefly with persons, and work dealing with such symbols as language or numbers. While classifications of this kind are usually intended to serve a "systematising" function, it is tempting to attach to them a psychological importance, and to regard individuals as differing in their ability to succeed in these separate groups of occupations.

* * * * *

The measurement of one or other of a person's specific abilities does not, of course, enable the whole range of his capacities /

capacities to be deduced, and, in any case, the influence of his general ability must be taken into account.

Nevertheless, we may conclude from the data provided in this report, that the threefold classification of occupations is probably more useful for boys than for girls. We may also suggest that the phrase "work requiring ability in spatial "perception" carries a more precise meaning than "work dealing with inanimate objects (or things)". Nothing can be said here as regards the abilities required in "work dealing with people" since the tests under discussion provide no relevant data.

* * * * *

It is in the situations of daily work where effort must be continued year after year that the question of interest in the material worked with becomes vitally important. It is quite impossible that a "practical type" exists, not necessarily in the sense that such persons have the ability to work best with concrete material, but in the sense that only by concrete material can they be stimulated by a sustained effort at or near the maximum.

If this be the case, how can such persons be identified? During the administration of the tests, individual variations in reaction to the test situation can be noted. Since such variations do not always affect the test scores, the existence of a "practical /

"practical bent" cannot be demonstrated by an statistical analysis. But observation shows that some individuals exhibit interest and confidence in their approach to the test problem while others appear bored and confused. No experimental data are at present available for determining the generality of such reactions in any one individual for all kinds of concrete material. Indirect evidence is provided by Freyd in connection with differences between the "socially and mechanically inclined". He found that in interests and in character traits a group of life-insurance salesmen differed markedly from a group of engineers. Assuming that such interests exercise a permanent influence upon a person's response to the demands of life, there are good grounds for making a distinction between occupations according to differences in the material dealt with, and according to the kind of response required. From this point of view, performance tests have a considerable value in the work of Vocational Guidance.

Summary

* * * * *

Each of the performance tests reveals the play of one or more special abilities, and, according to their correlations with the general factor "g" or with linguistic tests of intelligence, these special abilities play an important part in determining success in the tests. At the same time success in each /

each test also depends upon the factor of general intelligence, and, to the extent to which it does so, it may be regarded as a measure of intelligence. But the relative parts played by intelligence and by the special abilities required need careful consideration for each separate test. It is probable that the special abilities tend to show themselves more definitely about the age of puberty than previously.

* * * * *

The special abilities entering into the six performance tests under consideration appear to be unrelated except in the case of those in which spatial elements enter.

* * * * *

As to the existence of "group" factors over a wider range - such as the so-called "non-verbal" or "practical" ability - there is, however, no conclusive evidence. That there is a factor common to all the performance tests is certain; but whether it consists only of the "general factor" common to all mental tests or of this factor in combination with some group factor cannot be decided on the evidence of these results. Although there is apparently a specific factor in the intelligence group test which is not shared by the six performance tests (and therefore is suggestive of a "verbal ability" factor), it does not necessarily follow that the performance tests share a "non-verbal" factor.

The /

The abilities required for success in some of these tests (Cube Construction, Formboard, Mazes, Substitution) are related to proficiency shown during apprenticeship to certain manual trades.

Significant reactions are aroused by the situations created while the performance tests are being performed; systematic observations of these reactions are valuable in determining whether a suitable adjustment to particular kinds of work is likely to be developed.

APPENDIX No. 26

Comparison of Passage Printed and Typewritten.

It may be objected that a public utility has only to do its job soundly and efficiently, and the goodwill of the public will follow inevitably and without any special effort or organization. This view, however, seems to omit the peculiar characteristic of public utilities, that they are under a general obligation to serve the public and to render equal service without discrimination. They may not pick and choose their customers; and because the public demand is so varied in its nature, and the public is conscious of the obligations of the utility towards it, it cannot give every one the service which he expects, at the price which he thinks appropriate. It has to deal with extremely complex conditions and must always expect to find a fringe of the public whose demands it is unable to satisfy.

Elite

It may be objected that a public utility has only to do its job soundly and efficiently, and the goodwill of the public will follow inevitably and without any special effort or organization. This view, however, seems to omit the peculiar characteristic of public utilities, that they are under a general obligation to serve the public and to render equal service without discrimination. They may not pick and choose their customers; and because the public demand is so varied in its nature, and the public is conscious of the obligations of the utility towards it, it cannot give every one the service which he expects, at the price which he thinks appropriate. It has to deal with extremely complex conditions and must always expect to find a fringe of the public whose demands it is unable to satisfy.

Pica

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Appendix No. 27

AUTOMATIC RECORDERS

The Journal of the Municipal Tramways & Transport Association
Vol. 16, No. 10, November 1937.

It is stated in the Times of November 11th that experiments are shortly to be made in London with a device by which the point to point movements of omnibuses will automatically be recorded at traffic headquarters.

For some years a system has been used on the underground railways to shew the regularity or otherwise with which trains are running. At fixed points on the track the trains made an electric contact which is registered on a dial at headquarters. In addition the indications are publicly shewn on repeater dials at important stations (such as Piccadilly) for the education or entertainment of the public. Hitherto it has not been possible to apply such a system to omnibus movements as the vehicles have no defined track or fixed points of contact.

The method now devised for omnibus operation is to suspend across the roadway, at termini and selected intermediate points, a detecting wire electrically connected to an indication dial at headquarters. On the roof of each bus a coil will be installed carrying alternating current. Passage of the coil beneath the detecting wire will induce a current, which, on being transmitted to the central point, will operate the recording instrument. A separate dial and a separate frequency are to be used for each service /

Some Uses of the Punched Card

Firm	Work done
John Dickinson & Co. Ltd., Apsley Mills, Hemel Hempstead, Herts.	Statements of account. Analysis of sales. Sales ledger. Traffic control. Arrears.
Prudential Assurance Co.	Annual bonus certificates.
Tootal Broadhurst Co. Ltd., Manchester.	Purchases ledger. Sales ledger. Statements of account. Statistical returns (analytical). 100/1800 postings per hour.
Lever Bros. Port Sunlight.	Analysis of sales.
Noakes Bros., 16 New Street Square, E.C.4.	Invoices and monthly statements of account. Statistics.
Blackpool Corporation Transport Dept.	Waybill and complete tramway data. Costs and financial accounts. Pay bills.
Wolsey Ltd., Woollen Manufacturers, Leicester.	Wage roll. Stores ledger. Cost records.
Eagle Star & British Dominions Insurance Co.	Dividend payment warrants.
R. & T. Jennings & Sons Ltd., Boot & Shoe Manufacturers, Stafford.	Sales records.
Scottish Co-op Wholesale Society, Glasgow.	Departmental sales analysis.
Austin Motor Co. Ltd.	
Austin Reid Ltd.	Analysis of purchases, stocks and sales.

Wesleyan /

Firm	Work done
Wesleyan & General Assurance Society	Every kind of insurance. Ordinary, industrial, fire, motor, accident. All valuation statistics, new business clauses, surrenders, lapses, renewals, maturity, premiums and profits, mortality expenses, medical fees.
H. M. Stationery Office	Sales analysis
David Brown & Sons (Huddersfield) Ltd.	Stocks, costs, sales, pay roll.
British Piston Ring Co., Coventry.	Sales ledger, personal accounts, sales statistics, purchase ledger, nominal ledgers, payroll, costing.
Norwich Union Life Assurance Society	Bonus notices
Electricity Board for Northern Ireland	Continuous billing system. Costing, stores analysis, wages, debtors' accounts.
Sunderland Town Council	Expenditure on cleansing, and Education, embracing materials, labour, haulage, etc.
The Central Agency, Glasgow	Sales analysis, customers' ledger accounts, rendering of accounts, control of credits.
Imperial Tobacco Co. (of Great Britain and Ireland).	Bonus Department records.
Royal Army Pay Corps	Pay roll.
Skofabriksaktiebolaget Oscaria, Sweden. Shoes, socks, etc.	Sales analysis and stock control.
Royal Society of Medicine	Analysis of diseases, etc.
Airwork /	

Firm	Work done
Airwork Ltd.	Costing
Ardath Tobacco Co. Ltd.	Invoicing
Beacon Insurance Co.	Insurance Accounting
Blackpool Corporation Transport Department	Transport Accounting and Statistics.
Brighton, Hove & Worthing Gas Co.	Consumption Analysis and Appliance Records
Cornhill Insurance Co.	General Insurance Accounting.
R. & H. Green & Silley Weir Ltd.	Costing and General Accounting
Hull Corporation Electricity Department	Costing and Accounting
S. Lecash & Sons	Stock Control
London County Council Health Department	Hospital Records
Joseph Lucas Ltd.	Stock Control
National Health Insurance Society	Insurance Statistics
Newton, Chambers & Co.Ltd.	Costing, Payroll and Sales Analysis
Pickfords Ltd.	Traffic Accounts
Somerset County Council	County Council Accounting
Standard Life Assurance Co.	Bonus Notices
Stewarts Cash Stores Ltd.	Stock Control
United Co-operative Laundries Association Ltd.	Sales Ledger
United Dairies (London) Ltd.	Stock Control
Westminster Electric Supply Corporation Ltd.	Electricity Billing
Yale & Towne Manufacturing Co. Ltd.	Purchases Analysis

Extract from The Powers-Samas Magazine, March 1937.

A Problem in Alphabetical Sorting
by A. P. Hodges

I have worked out what might be called a Special Numerical Code, which has the following main features:-

(a) Although a numerical code, it enables cards to be sorted alphabetically up to three columns, reducing the number of sorts from six to four.

(b) The coding, decoding or checking of the first three figures can be done at sight, i.e. without reference to a code index.

(c) The danger of transposition of figures is minimised for the reason given in (b).

Supposing the customer's code is to consist of a prefix corresponding to the first three letters of the customer's surname and three numbers which indicate the particular account.

Under the special code system a further prefix number would be added to indicate what may be termed the alphabetical group.

The resulting seven-figure code would therefore be:-

Group No.	Prefix	Account Code Suffix
1 figure	3 figures	3 figures

The prefix would be extremely simple and therefore easy to memorise, the first three letters of the customer's name being /

being given numbers as below:-

0	=	A or L
1	=	B or M
2	=	C or N
3	=	D or O
4	=	E or P Q
5	=	F or R
6	=	G or S
7	=	H or T
8	=	I J or U V
9	=	K or W X, Y Z

In a very short time it would be possible for a clerk to code at sight from the above as follows:-

Arnold	052	Leonard	043
Barker	105	Mason	106
Cummings	281	Niblick	281
Dawson	309	Olsen	306
French	554	Repton	544
George	643	Spong	643
Holman	730	Toller	730

These few examples have been chosen to show that names such as

Cummings and Niblick	281
George and Spong	643
Holman and Toller	730

have the same prefix.

In order to avoid any confusion, to indicate the actual first three letters of the surname, to retain the advantages of numerican sorting and yet to get the cards in alphabetical order, the group code is now used. This single-figure code indicates to which half of the alphabet the prefix letters belong. Supposing A represents the first half of the alphabet, and X the second, then in a three-letter code any group of three letters must come into one of eight groups, which /

which are very simple and easy to remember.

1. AAA all letters in first half of alphabet.
2. AAX first two letters in first half, third in second half.
3. AXA first and third letters in first half, second in second half.
4. AXX first letter in first half, second and third letters in second half.
5. XAA first letter in second half, second and third in first half.
6. XAX first and third letters in second half, second in first half.
7. XXA first two letters in second half, third in first half.
8. XXX all three in second half.

Now taking the names already mentioned, we get groups and prefixes as follows:-

Arnold	4281	Leonard	6043
Barker	2105	Mason	6106
Cummings	4281	Niblick	5281
Dawson	2309	Olsen	8306
French	3554	Repton	6544
George	2643	Spong	8643
Holman	4730	Toller	8730

To sort in alphabetical order, ignoring the suffix columns which are straightforward, and need not be included here:-

1. Sort on group column. This divides cards into eight packs.
2. Sort each of the eight packs separately on the third column of the prefix (i.e., on the right-hand column).

3./

3. Sort packs 1 and 2 together on the second column of prefix and do the same with packs 3 and 4, 5 and 6, 7 and 8.

4. Sort packs (1 + 2) and (3 + 4) together on Column 1 of prefix, and do the same with packs (5 + 6) and (7 + 8).

The cards are now in strict alphabetical order (assuming that the suffix sort had first taken place), including the combined letters IJ, UV, etc.

These combined letters are such that they need not cause any confusion as they can be indicated by the suffix, although not so clearly as in the case of the prefix.

In the London Telephone Directory the names beginning with:-

I	form	about	8	per	cent.
J	"	"	2.1	"	"
Q	"	"	.1	"	"
U	"	"	.6	"	"
V	"	"	1.3	"	"
X	nil				
Y	"	"	.5	"	"
Z	"	"	.2	"	"

It must also be remembered that when letters like I and J are considered, a name beginning with I is nearly always followed by a consonant, while J is followed by a vowel.

The same remarks apply to U and V and also to a less extent to W X Y Z.

The letter P is never followed by Q, and Q is always followed by U.

In /

In nearly all cases, therefore, it is not difficult to recognise which letter is meant of two or more combined in one figure, and when the account numbers are allocated, in the case or combination letters, it is simple to allocate groups of numbers to indicate the first letter of the name, as for example.

001-499	can be allocated	to names beginning with	I
500-999	do.	do.	J
001-899	do.	do.	P
900-999	do.	do.	Q
001-299	do.	do.	U
300-999	do.	do.	V
001-799	do.	do.	W
800-899	do.	do.	Y
900-999	do.	do.	Z

This form of code also allows for considerable expansion as 999 figures are available for each combination of three letters and the suffix can be so arranged as to take care of combination letters where they occur in the second or third columns of the prefix.

BULK EXTENSION, or SUMMARY MULTIPLICATION

There are still many firms to whom stock valuation is a real problem causing the whole accounting organisation to be temporarily thrown out of gear and immobilising a large proportion of the staff for several days. Any amelioration of these conditions will undoubtedly be welcomed and it is with this thought in mind that the following description of a simplified method of stock valuation is presented.

At most stocktakings we find that the penultimate result is a comprehensive list of quantities and values each of which has to be multiplied out in order that the total value of the stock may be ascertained, and it is almost invariably assumed that the only way to arrive at this total value is to compute each separate extension and then to add up the values of the individual items so ascertained.

Actually it is seldom that one is interested, during a stocktaking, in the value of each particular item of stock. The one thing that matters is the accurately compiled value of the total stock, and we feel sure that our method of obtaining this by bulk extension on Powers machines will demonstrate that in stock valuation, as in all other accounting work, the Powers way is the better way.

The Powers method of bulk extension comes into operation at /

at the point where the detailed schedules are usually handed to clerks for the extensions on each line to be effected. Instead of commencing these multitudinous and tedious calculations we proceed as follows:-

First we punch a card for each line of stock, the only particulars requiring to be punched being:-

1. Quantity (irrespective of unit of quantity).

2. Unit value, i.e., price per unit (in £.s.d. as the case may be).

Secondly, we check the punching of the cards, if necessary by comparing a tabulation of the cards with the original entries and also the totals of both the quantities and the unit values with similar totals obtained from the original entries.

We then sort the cards according to the unit figures of the quantity.

All quantities ending in "9" will fall into one group.

All quantities ending in "8" will fall into the next group and so on and so on.

We then pass these cards in their thus classified groups through the tabulator, and we produce a detailed tabulation as follows:-

Quantity	Unit Value £.	s.	d.
..19		4	6
...9		3	7⅛
..39		2	4¼
.109			7¾
...9		14	8
..79		13	6
..39	1	4	7½

Etc. etc.

If /

If we take a total at the end of each of these groups we obtain the totals of the unit values corresponding to each final integer of the quantity designation thus:-

Quantity Designation	Totals of Prices per Unit
...9	£138.15. 7½
...8	89. 8. 7
...7	94.15. 6
...6	87. 2. 6½
...5	145. 8. 9
...4	135.14. 8
...3	112. 2.11½
...2	123. 5. 6
...1	145. 9.10
...0	198. 8. 7

Providing that our stock consists of not more than nine of anything the simple multiplication of the quantity designation figures shown above with the totals of the unit values against those designations will give us the total value of stock in respect to each of the above quantities. By adding up the results so ascertained the result will be the complete value of the stock. We can see from the above that we do not require to tabulate the quantities ending in "0" since no matter what the unit value may be "0" multiplied by that value = "0".

It so happens that the Powers Tabulator is fitted with what is termed an Accumulative Total Device. This device merely arranges that after each total is printed it remains in the machine.

By means of this device we can see that after the total of /

of quantity designation "9" (i.e., £138.15. 7½d.) has been printed it will remain in the machine. Therefore when the total for quantity designation "8" (i.e., £89. 8. 7d.) is compiled it will add itself on to the £138.15. 7½d. that has already been accumulated in the machine for quantity designation "9". The total shown against designation "8" will therefore be £228. 4. 2½ which, of course, is £138.15. 7½d. + £89. 8. 7d.

Again this amount of £228. 4. 2½d. having printed itself will remain in the machine and add itself on to the subsequent amount for quantity designation "7".

We can see therefore that our schedule can be produced in the following form:-

Quantity Designation	Accumulated Prices-per-Unit Totals
...9	£ 138.15. 7½
...8	228. 4. 2½
...7	322.19. 8½
...6	410. 2. 3
...5	555.11. -
...4	691. 5. 8
...3	803. 8. 7½
...2	926.14. 1½
...1	1,072. 3.11½

We now know that in the above schedule the total for quantity designation "9" has appeared on each line, which (the "0" group being omitted) is, of course, nine times.

The total for quantity designation "8" has appeared eight times and so on and so on.

Therefore, if we make the simple addition of the nine totals shown /

shown in the above schedule we shall have achieved the same result as if we had carried out the multiplication necessary to the previous schedule. In fact on the second occasion our tabulator took care of the multiplication and all we now have to do is to add nine lines of figures.

But here again our tabulator will come to our aid because each unit of a tabulator can be equipped with a Grand Total Attachment. This means that in addition to the totals being individually accumulative the totals so arrived at are in turn transferred to the Grand Total Unit and the final addition of such accumulated totals expressed from the Grand Total Unit.

This finally printed result will be the same figure as that arrived at from the addition of the multiplications shown in Process 1.

Having achieved this result we then re-sort our cards into the "tens" figure of quantity, because so far we have only dealt with the terminating integers of the stock quantities.

We now have ten groups of cards wherein the quantities end in:-

Ninety something
eighty "
seventy "
and so on.

A further tabulation in this order showing the accumulative totals of the unit values of each of these groups will give us the totals of the unit values of these groups as follows:-

Quantity /

Quantity Designation	Accumulated Price-per-Unit Totals
...9	£ 76. 8. 7
...8	141. 9. 3½
...7	207. 1. 6½
...6	258. 6. 2½
...5	381.17. 9
...4	493.13. 6
...3	596. 8.10
...2	760.18. 5
...1	944.10. 1½
	£3,860.14. 3

These groups, however, are "tens" groups and since we have only accumulated the unit values we must multiply the final result by ten in order to arrive at the stock value in respect to these "tens" of quantities. This figure we must add to the first group of unit figures.

Similarly we then re-sort the cards on the "hundreds" figure of quantities and a similar tabulation gives us the total of the unit values in respect to the "hundreds" group which when ascertained must be multiplied by 100.

A further refinement and great advantage in the preparation of the tabulations is to arrange for additions of the unit values to be duplicated in two adjoining sections of the tabulator, only one of which is allowed to retain the accumulative totals of the group.

In one section we shall then be expressing the sub totals of each of the groups with a grand total inclusive of the "O" group /

group, while in the adjoining section we shall accumulate the accumulating totals of each of these sub groups, but excluding the "0" group.

In this way the grand total of the sub totals (including the "0" group) must be the same for each of the tabulations under the various headings of:-

(1) units of quantities,

(2) tens of quantities,

(3) hundreds of quantities, and so on.

Thus we shall automatically demonstrate that all our cards are included for every tabulation.

It can be seen from the above description that a stock valuation of, say, 10,000 different lines, instead of involving 10,000 extensions, can be reduced to <u>three multiplications</u> (viz., by 10, by 100 and by 1,000) with a simple addition of the results so ascertained in order to arrive at our total stock value.

The outstanding consequence of this particular method is that the whole job of stock valuation can be handed over to those who are not necessarily skilled in the art of extension work.

We are confident that those who have been faced with this task, which must necessarily be accomplished in a short space of time, will readily appreciate the advantage of being able to hand /

hand this job over to a staff which, although unversed in the art of multiplication, is eminently capable of the transcription portion of the work.

Attached we show in full the actual tabulations which arise in respect of a stock valuation which, in the usually adopted way, would have involved between sixteen and seventeen thousand £.s.d. multiplications.

Each one of these thousands of extensions would have needed checking before the final addition of the values could be accepted as the stock valuation.

In order to facilitate these operations it would undoubtedly have been found advisable to decimalise the unit values in order to make use of a calculating machine.

The Powers Way, as can be seen, avoids all such labours and merely involves the transcription of the quantities and unit values into punched cards at a speed approaching a thousand cards per hour.

The sorting and tabulating involved which produces the final result is a matter of simplicity in routine work and the time involved directly related to the number of items concerned.

Assuming a limit of three figures in the size of the quantities the final result would be achieved in a maximum of three hours for each 5,000 lines of stock involved. Each tabulation under its three stages of "units", "tens" and "hundreds" /

From the Tabulator.

"hundreds" automatically exhibits its accuracy by the repetition of the grand total obtained under each tabulation.

A discrepancy can only arise from an inaccurately punched card and at any time the figures may be challenged and substantiated by comparing a tabulation of the punched cards with the original stock lists.

From the Tabulator.

SUMMARY MULTIPLICATION

Summary multiplication, or progressive digiting, recognises multiplication as multiple adding. Thus, if those quantities which are to be multiplied by 9 are grouped and added nine times, we have multiplied by 9. Similarly those to be multiplied by 8 are grouped and added eight times, and so on down to 1.

The following table and explanation will perhaps serve to make this clear:-

A. Units		B. Quantity	C. Progress Total	
9	x	10	10	= 10
8	x	25	35	= 10 + 25
7	x	15	50	= 10 + 25 + 15
6	x	32	82	= 10 + 25 + 15 + 32
5	x	15	97	= 10 + 25 + 15 + 32 + 15
4	x	5	102	= 10 + 25 + 15 + 32 + 15 + 5
3	x	20	122	= 10 + 25 + 15 + 32 + 15 + 5 + 20
2	x	10	132	= 10 + 25 + 15 + 32 + 15 + 5 + 20 + 10
1	x	5	137	= 10 + 25 + 15 + 32 + 15 + 5 + 20 + 10 + 5
		Times added		9 8 7 6 5 4 3 2 1

Two conditions are essential to the working of the plan, viz., the rate must be given in decimals in one common measure, and must be expressed in terms of the same unit as the quantity: for example, tons at so much per ton: dozens at so much per dozen.

After punching and verifying, cards are sorted to the unit column A, and in order to ensure (for example) that the nines are added nine times, cards are abstracted from the Sorter in reverse order and presented to the Tabulator 9, 8, 7, 6, etc., instead of the usual 1, 2, 3, 4, etc.

The Tabulator is set to control on the unit column A, and the Quantity field B is plugged to another counter. The latter plugging is duplicated on a third counter C in which to obtain progressive totals, which are the figures required.

The /

The same sorting and tabulating process is repeated for each and every column of the unit price, remembering that as the second tabulation was for the 'tens' digit, one nought must be written to the right of the total, and in the case of the 'hundreds', two noughts. When the grand total is struck, point off as many places in the total as there are decimals in the unit price field.

As progressive digiting is based upon the inclusion in progressive totals of each group total as many times as expressed by its value, care must be exercised to guard against missing digits in any of the sorts. This can be taken care of by the manual insertion of cards punched with the missing digit, after inspection, or by the use of nine pre-punched cards which should be punched for the entire range of the card covering the number of sorts to be made in the unit price field.

Since the noughts are a negative quantity they are used to establish a control figure only, and are entered at the bottom of the sheet as shown in the illustration. For instance, the tabulation of the noughts in the unit field gives 14. If 14 be added to the progressive tabulation of the 'ones', a total of 3564 is obtained. This figure should be the same for each tabulation, thus proving that no cards have been missed at any stage.

The following example shows a list of items which have been valued by the usual manual methods of individual extensions. -

Quantity /

Quantity			Rate £		£
128	doz	@	.07	per doz.	8.96
34	gross	@	2.84	per gross	96.56
69		@	.81	each	55.89
58		@	1.14	"	66.12
297	pairs	@	2.67	per pair	792.99
345		@	.13	each	44.85
15	galls.	@	.34	per gall.	5.10
195		@	3.22	each	627.90
36		@	5.33	"	191.88
295		@	.63	"	185.85
343		@	1.19	"	408.17
75		@	2.21	"	165.75
69		@	.89	"	61.41
142	yards	@	.74	per yard	105.08
341	"	@	.77	" "	262.57
398		@	.04	each	15.92
62		@	1.72	"	106.64
14		@	3.50	"	49.00
3		@	2.25	"	6.75
58	yards	@	.72	per yard	41.76
69		@	.89	each	61.41
435	feet	@	.04	per ft.	17.40
83		@	1.17	each	97.11
3564					£3,475.07

849

(.07

14 noughts

128
398
435

961 noughts

Here is the same result obtained by the Tabulator employing the Progressive Digiting Plan.

Whilst it is not actually necessary in practice to print the individual group totals, they are shown in this illustration in order that it may be clear what takes place.

This method can be utilised for a number of purposes, prominent among which is the valuation of Stock Inventories where it is desired to obtain the total value of stock at the earliest possible moment.

		Quantity	Progressive Quantity	Sum of Progressive Quantity
Hundreds Tabulation	9	481	481	
	8		481	
	7	849	1330	
	6		1330	
	5	3	1333	
	4	1082	2415	
	3	676	3091	
	2	315	3406	
	1	144	3550	174.17
Tens Tabulation	9			
	8	241	241	
	7	603	844	
	6	592	1436	
	5	14	1450	
	4		1450	
	3	51	1501	
	2	273	1774	
	1	829	2603	1129.90
Units Tabulation	9			
	8			
	7			
	6			
	5	36	36	
	4		36	
	3	209	245	
	2	109	654	
	1	546	1200	2171.00
				3475.07 (Two places of decimals)
Noughts (Units)		14	3564	
Noughts (Tens)		961	3564	
Noughts (Hundreds)		2364	3564	This figure is composed of machine total + non-recording noughts.

While from the reading of this procedure for summary multiplication it may appear complicated, in practice this is far from being the case. The plugging of the tabulator and the refeeding of the cards each time the tabulator is reset is all that is involved. On the other hand the savings in the punching of cards may be very considerable.

APPENDIX No. 31

EDINBURGH CORPORATION GAS DEPARTMENT

Analysis of the Net Cost of Gas

	1934	1935	1936	1937	1938	
Manufacture (net) . .	1/ 7.83	1/8.37	1/7.94	1/10.79	2/1.08	
Residuals . . .	1.37	1.32	1.44	1.41	1.31	
Total . . .	1/ 9.20	1/9.69	1/9.38	2/0.20	2/2.39	
Less Revenue for Residuals . . .	9.88	10.54	11.04	1/2.27	1/3.48	
Net cost of manufacture	11.32	11.15	10.34	9.93	10.91	
Distribution (net) .	5.62	4.90	5.57	5.41	5.42	
Rent, Rates, Taxes and Insurance . . .	2.27	2.24	2.34	2.26	2.23	
Administration and General Exps. (net) .	2.54	2.49	2.45	2.23	2.24	*
Miscellaneous expenditure . . .	0.92	.93	.87	.86	.85	
Less Miscellaneous revenue . . .	.38	.44	.46	.49	.53	
Net . .	.54	.49	.41	.37	.32	
Net cost per 1,000 cu.ft. of Gas sold . .	1/10.29	1/9.27	1/9.11	1/8.20	1/9.12	
Interest and Sinking Fund Charges, etc. .	10.32	10.64	9.26	9.11	8.19	
Total . .	2/8.61	2/7.91	2/6.37	2/5.31	2/5.31	
Percentage of net cost of Gas represented by Administrative Charges . . .	11.40	11.71	11.61	11.04	10.61	*

Extracts from Report (1928) by the Post Office Savings Bank on Mechanised System of Ledger Postings.

Illustrating the care expended on the facilitative aspects of mechanisation:-

"A depositor's card may be coloured pink, blue, green, yellow, buff or white. As a precaution agains t the misplacement of cards, no adjacent offices have cards of the same colour. The cards are kept in sloping card tables made of steel and specially designed for the Savings Bank Department. All the measurements have been designed to give the worker the maximum amount of comfort and ease, numerous numbered guide cards assist her to find the card she wants. The floor of the card container slopes upwards from the front, so that a person seated in front of the table with a normal length of arm can reach the back cards without an uncomfortable stretch and has a clear view of all the guide cards. The cards relating to any Post Office run in numerical order, but not in a consecutive sequence, because Savings Bank depositors are a changeable body. Their total number remains fairly constant, but that is because new depositors come in to replace those who have dropped out. The newcomers get new numbers, those who close their accounts leave gaps, so that whereas the youngest cards of an office run in an almost continuous sequence, the earlier numbers may often jump by hundreds. Careful experiment indicated the number of guide cards required to enable the selector to find her cards in the shortest possible time."

Illustrating the care exercised in control:-

"The documents relating to each class of transaction are dealt with as a separate piece of /

of work. They are separated into bundles, each covering a Ledger "Division" of about 30,000 accounts. The object of breaking up the work in this way is that presently someone has to see that the totals of the amounts entered on the ledger cards equal the totals on the Postmaster's sheets. If they do not, the mistake has to be found, and the proportion of 30,000 accounts which is being operated on is quite a large enough bundle of hay in which to look for the needle. The number of documents in each bundle is noted by the clerk in charge of the particular card table concerned and is a check on all the subsequent stages of the affair. She then gives the bundle to one of her subordinate officers with a corresponding number of "signal cards". The principle in force is that no card is taken out of the table without a signal card being put in to take its place - not only to show that it <u>is</u> out, and so act as a danger signal, but to provide a clue to its whereabouts in case it is wanted for another purpose. The signal card is brightly coloured and has an alarming constellation of stars on the edge which projects above the account cards, so that it cannot escape notice in the tables. It also bears an abbreviated description of the class of transaction in connection with which it has been taken out. Different coloured signal cards are in use for different days, and the sight of a Wednesday's signal card still in the tray on Friday means that an account card has been out of its place too long."

"The bundle is now ready for the machine operator, who places on a table at her left hand the bundle of documents and the bundle of cards, sets her machine for deposit or withdrawal, and one by one makes the entries on the cards and adds them to the mounting heap on the table at her right hand. She works at the rate of about 400 entries an hour. An item counter on the machine records each entry so that at the end of the operation the number shown may be checked against the number of documents/

documents already recorded, and any item missed or entered twice may at once be brought to light. And - here is the central fact of the situation - as the machine makes the entries it is adding them up, so that when the operator has made the final entry she is able to print off automatically on a separate slip of paper called the "control slip" the total amount of the particular transactions entered that day for this particular "Division" of offices. This total should of course agree with the total arrived at by adding up the amounts shown on the separate documents, and steps are taken at once to see that it does. Either a separate list of the amounts on the documents is made by an operator on another machine, or if the number of documents is small, the amounts are added mentally by a Clerk."

Illustrating appropriate division of labour to ensure feed:-

"The "Selector" then takes her bundle of signal cards and sits down to her table to select the accounts required. A travelling "bridge" moves noiselessly along the table on rubber wheels and serves her as a desk. Her movements are as carefully studied as those of a Ford mechanic, and gradually she works up to a very good speed considering that as she takes out each card she has to verify the name of the depositor as well as the office and number. Sometimes she meets a difficulty. The office and number correspond, but the name does not; or perhaps no such account appears to exist. Such queries she puts on one side for investigation by the clerk at the head of the table, who tries to get them all settled by the time the remainder of the bundle of cards is ready. The selector reports the number she has selected, which should agree with the number of documents already recorded."

Illustrating the ease with which accuracy in machine accounting is ensured:-

"It is at this point that the machine posting process has such an advantage over the old method of entering transactions by hand in bound ledgers. In order to prove that the amounts that had been o/

been entered in the ledgers were the amounts that ought to have been entered they had to be summarised at quarterly intervals by manuscript "extraction" from the accounts, and totalled and compared with the figures arrived at from the quarter's posting documents. This was a very laborious process, and not unnaturally mistakes were made in the process of extracting which added to the difficulty of making the two totals agree. When it is mentioned that offices with as many as 16,000 accounts and a total of £100,000 for the quarter's transactions were balanced as one unit, the difficulty of finding particular posting errors which might have occurred on any day in the quarter will be plain. The machine process gains in two ways. First it is not so easy to make a mistake in the first instance. Entering the wrong amount is less frequent by machine than by hand; it is for the psychologist to say why. Posting to the wrong account is less frequent because two people compare the particulars, the selector of the card and the machine operator, instead of the single clerk whomade the entry in the bound ledger; and posting a single deposit as a withdrawal or vice versa is out of the question because the machine is set for deposits or withdrawals before the posting of any particular block of work begins. But there is a second advantage in the machine process. If a mistake of amount has been made it is discovered as soon as the total which the machine has recorded for the block of work is compared with the corresponding total from the documents. Thus from day to day the ledgers are in a state of very satisfactory accuracy, and the number of discrepancies which have to be adjusted when deposit books come to the Department for comparison with the official ledgers is very much reduced. The process of balancing the ledgers quarterly disappears altogether, and though there remains an annual balancing process, it is very much less lengthy and laborious than the balancing of the four quarters."

Illustrating need for an intelligence scrutiny which is generally incapable of mechanisation (see also Gas Department diagram showing function of scrutiny):-

"When each block of accounts is finished the cards are looked through by the clerk in charge in case /

case they are specially noted in any way, or are full in either column; she also sees whether the book is due for annual examination, and attends to various other points which are not susceptible of mechanical treatment."

Illustrating the results of careful study of facilitative aspects:-

"The signal card is in the tray to indicate the place from which it came. So this part of the work goes at a very rapid rate; many replacers put their cards back at 500 an hour. It is worth noting incidentally that it is very rare indeed for one to be filed in the wrong place. The experience of the Savings Bank with its enormous range of accounts has been altogether reassuring as regards the danger of ledger cards being lost or misplaced."

Illustrating the popularity of machine posting:-

"She will have spent her day on these two operations (selecting and replacing cards) varied by a period of operating the machines. On the whole, she probably prefers the machine operating; it is generally very popular."

Illustrating the need for good organisation to ensure a steady flow and avoidance of peaks:-

"If one of her operations is badly in arrear she may hold up the whole progress of the work. In some ways machinery is a hard master. The very fact that a machine works much more quickly than a human being means that a comparatively small equipment of machines will suffice to keep the work going in ordinary course. A machine moreover is a specialist and generally speaking will only do its own job. If therefore anything goes wrong it is not possible as it is with human beings to hurry up large reserves to the rescue. Consequently the work must be kept in steady and regular movement by good organisation. When it is remembered that the fluctuations of work are large /

large - Savings Bank depositors having the habit of making nearly twice as many deposits on a Saturday, for instance, as they do on a Wednesday - it will be realised that it is a pretty problem of management to keep the staff steadily employed, and to complete the work regularly, on every day of the week including the Saturday half-holiday. At 5 o'clock each day, when the roll tops are carefully drawn over the cards and the locks slip into position, no work must be left over except the varying amount sufficient to keep the staff employed before the new work is ready."

"It is her (supervisor's) business to get the day's work done in the day, and to watch her officers closely and see that they reach the maximum output with the minimum of fatigue."

Illustrating that mechanisation begets precision of thought and method:-

"It remains to describe the process of balancing the ledgers annually. The interest for the year is calculated mentally and entered by hand in the account and the two sides are balanced in manuscript as soon as possible after the 31st December in order to arrive at the new principal for the next year. The work is for the most part done in the evenings in January, and it was something of a problem at first to see that all the cards were dealt with, since some of them were necessarily out of their places in order that deposits or withdrawals might be entered. This difficulty has been overcome by a simple device. The clerk making up the accounts in a particular block finds that a card is in use away from the table. The signal card which represents it shows her for what class of transaction it has been taken out. If that class is such that the account will not be made up in ordinary course before the card is replaced, she slips a paper clip on to the signal card. Next morning the replacer putting away her cards sees the clip and knows that the card needs attention before it is replaced in the tray. The mechanical atmosphere, so to speak, stimulates thought on these lines, and the officers engaged on the work are constantly suggesting devices by which human effort can be minimised."

Illustrating the limitations on machinery. - Lack of decimalisation:-

"It would be even better if the deposit columns could also be totalled in the course of listing, but at the present stage of mechanical evolution the machine is only equal to this additional feat when decimal coinage is used."

Illustrating the preliminary study involved in a large and costly scheme of mechanisation:-

"Innovations of this character in a deep-rooted and successful system that had been in force for over sixty years could not be introduced without a great deal of preliminary thought and investigation. The whole field of office machinery was first surveyed, and exhaustive tests were carried out with the different makes of machines that were then available. The next step was to make a decision between card and loose leaf ledgers. The one offered greater flexibility, the other more security against loss. After careful test, and despite a general prejudice prevailing at that time against cards, the decision was made in their favour. The rates at which they can be handled surpass anything attainable on a loose leaf system where a large field is covered and the accounts are comparatively inactive.

The danger of lost cards was naturally a matter of considerable concern in arriving at this decision, but it was judged that a carefully organised system of control, such as has already been described, would guard against this and practical experience has very fully vindicated this judgment."

"Most of the furniture adopted for the new system was specially designed with the helpful collaboration of the Office of Works, as it was found that standard card ledger equipment would not provide economically for the large number of Savings Bank accounts."

"When these various requirements had been studied and supplied, steps were taken with the active co-operation of the machine Companies to train operators in the use of the posting machines and /

and by means of dummy cards, tables, and accounts, to practise selectors in handling the cards.

In 1926 an experimental trial was made for a year on a small portion of the ledgers. The experience gained during this trial paved the way to a further extension in the following year, and the success which attended this wider experiment led to the decision to extend the use of machines throughout the whole system in the course of 1928 and 1929."

Showing the economies resulting from successful operation of machines;-

"A careful preliminary survey of all the possibilities, thorough test and rehearsal, stage-by-stage extension, and a public-spirited response by the staff to the demands of a new system have been the salient features of this virtual revolution in the largest institution of its kind in this country. It is satisfactory to note that the work of copying particulars of 10,000,000 accounts on to cards, involving 400,000 hours of clerical work, has been met out of economies, and that when the transition is complete a saving of human labour to the extent of over half-a-million hours a year will have been secured."

Extracts from Post Office Savings Bank Green Paper 30A.

APPENDIX No. 32

The year 1926 marked the beginning of the most revolutionary change in the Department's internal system - the application of machinery to the posting and balancing of depositors' accounts.

*As far back as 1910 calculating machines were brought into use in the balancing branches, and the Bank to-day boasts the largest collection of these machines in the country.

We do not think it is going too far to say that the Savings Bank is ahead of any comparable private concern in the adoption and development of office mechanisation and labour saving devices.

How is this mechanisation reflected in the costs of running the concern.

Year to 31st Dec.	Deposits		Withdrawals		Remaining Active Accounts	Expenses of Manage-ment	Rate per cent. to total amount at credit of depositors.
	No.	£	No.	£	No.		
1870	2,135,993	5,995,121	787,172	4,758,187	1,183,153	67,945	9/-
1890	8,776,566	20,990,692	2,892,006	17,908,860	4,827,314	326,394	9/8
1910	19,975,375	46,205,870	10,058,009	45,861,181	8,371,789	608,913	7/2*
1930	22,880,244	76,120,515	10,129,720	77,694,381	9,229,196	1,227,126	8/5
1935	24,771,000	116,219,000	12,307,000	89,653,000	9,764,000	1,304,593	6/8

APPENDIX No. 32

CORPORATION of the CITY of EDINBURGH

STATEMENT shewing COST of CITY COLLECTOR'S DEPARTMENT during the Years from 1929-30 to 1936-37.

Expenditure on -	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Salaries, Wages and Allowances . .	£21,743,17, 9	£21,556. 8. 4	£19,083.10. 1	£15,592. 2. 5	£13,684.17.10	£10,596. 9. 1	£ 9,815. 1. 6	£10,219.18.10
Guarantee Premiums	30.19. 5	32. 3.11	24.13. -	18. 9. -	13.18. -	17.10. 1	13. 3. -	15. 8. -
Valuation of Lands, etc., Account, for preparation of Burgh Assessment Books . .	2,500. -. -	2,500. -. -	2,600. -. -	2,400. -. -	2,400. -. -	2,400. -. -	2,400. -. -	2,400. -. -
Printing and Postage of, and Receipt Stamps on Demand Notes, Stationery, Printing and Advertising, Stamped Receipts for Assessments and other Revenues	3,719. 1. -	3,260. 5. 2	2,822. 5. 3	2,975. 2. 3	2,240. 3. 8	2,948. 3. -	3,144. 9.10	3,507. -.11
Preparation, etc., of Demand Notes	-	-	-	-	750. -. -	750. -. -	750. -. -	-
Commission to Owners for Collection of Rates on Small Dwellings, and Commission to Banks for collection of Corporation Revenues . .	5,684. 7. 8	8,308. 4. -	7,700. 8.10	9,020.15.10	9,580.12. 1	8,759. 7. 6	8,962.13. -	10,201. 5. 2
Postage of Assessments and other Demand Notes .	689.10. 6	875. 6. 3	376. 9.10	380. 1. 6	360. 1. -	167. 4. 1	-	-
Office Furnishings	293.16. 8	221. 1. -	204.11. 2	30. 6. 8	81. 8. 4	140.17. 8	302. 7. 2	137. 1. 7
Special Expenses as Local Taxation Officer .	563. 9. 2	508.10. 7	429. 7. 4	531.18. 3	444.12. 7	3,091.19.10	3,032.17. 6	3,109. 1. 8
Petty Outlays, Incidental Expenses and Expenses of Showroom Collection, Tokens, Summing Warrants, etc.	2,356.19. 1	984. -. 4	1,021. 8. 5	876. -. 4	958. 8.10	1,008.10. 2	1,495. 7. 7	1,259. 1. 6
Motor Car Department	179. 1. 4	186.12. 6	175. 8. 4	135.10. 1	129.14. 9	130.17. 1	134. 4. 6	143. 1. 9
Maintenance of Office - Caretakers, Cleaners, Heating, Lighting, etc.	1,553. 3. 3	1,865.19. -	1,736. 1. 1	1,632.10. 6	1,540.13.10	1,174.12. 4	1,048. -. -	1,065. -. -
Sheriff Officers' Commission on Local Rates Collected	-	986. 6. 8	496. 3. 3	461. 2. -	594. 5. 9	1,312. 4. 1	707. -. 6	762.11. 3
Debt Recovery Agents' Fees, etc., - Rents, Gas, Electricity, etc.	-	655.12. 1	727.15. 3	776.11. 5	771.19. 5	478.11. 6	365.13. 5	251. 9. 6
	£39,314, 5.10	£41,940. 9.10	£37,398. 1.10	£34,830.10. 3	£33,550.16. 1	£32,976. 6. 5	£32,170.18. -	£33,071. -. 2

	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
Abatements by Treasurer's Committee on grounds of Poverty	£ 10,629	£ 9,934	£ 7,371	£ 6,343	£ 6,245	£ 6,347	£ 5,950	£ 6,767
Repayment of rates not recovered by S.D. owners .	1,290	1,319	1,109	1,251	1,222	1,632	1,431	2,305
Rates written off as irrecoverable . . .	1,281	2,297	1,239	459	3,446	7,747	2,921	2,412
Total rate charge	2,207,811	1,981,385	1,907,130	2,082,730	2,123,141	2,145,535	2,187,808	2,236,284
Amount outstanding at end of year	20,404	13,795	18,428	30,904	30,330	16,549	13,385	13,591
Percentage of Total rate charge	.924	.696	.966	1.484	1.429	.771	.612	.608
Gas - Total Revenue	628,794	636,067	646,696	647,406	648,356	652,020	689,012	755,453
Bad Debts	1,486	963	701	705	364	1,151	884	1,001
Percentage of Total Revenue . . .	.236	.151	.108	.109	.056	.177	.128	.133
Electricity - Total Revenue (Distribution). .	675,564	732,694	719,655	769,499	836,676	859,808	919,540	1,011,035
Bad Debts	1,285	490	470	492	592	949	891	1,126
Percentage of Total Revenue . .	.190	.067	.065	.064	.071	.110	.097	.111

APPENDIX No. 33

EDINBURGH CORPORATION ACCOUNTS

The Old and

The New.

[illegible] Anno [illegible]

The [illegible] day the auditor of Compts [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] That the Compter [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Compts And [illegible]

[illegible]

Mastr John [illegible] [illegible] [illegible] William [illegible] [illegible] William [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible]

[illegible]

Item [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

A° 1553 / 1554 } Ro. Grahams

The Compt of Robert

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 1554

The Chardge

Item in primis the Compter chardge [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Item the Compter chardge him [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

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Item the Compter chardge him [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

City and Royal Burgh of Edinburgh

No.

General Cash Book. Year 1930-31

Old Balance	Date	Narrative	Ledger Folio	Voucher No.	Payments	Receipts	Balance	Old Balance	Proof
									0 0
1881. 1.10	OCT 10 30	TO ALFRED SMITH & SON, 8TH INSTALMENT, CONTRACT FOR WIDENING OF LOTHIAN ROAD	4	2889	280. 0. 0		2161. 1.10	1881. 1.10	280. 0. 0 ....
11150.13. 0	OCT 10 30	TO WAGES, CLERK OF WORKS, 2 WEEKS TO 11TH OCT.	1	2797	10. 0. 0		11160.13. 0	11150.13. 0	10. 0. 0 ....
162. 0. 4	OCT 10 30	TO JAMES FRASER, SOLICITOR, PRICE OF SUBJECTS .319 ACRE OF GROUND AT KIRK LOAN, CORSTORPHINE.	2	2799	315. 2. 6		477. 2.10	162. 0. 4	315. 2. 6 ....
346.19. 4	OCT 10 30	TO JAMES SMITH, FIREMAN, ALLOWANCE, 4 WEEKS TO 11TH OCTOBER.	3	2832	6. 7. 6		353. 6.10	346.19. 4	6. 7. 6 ....
308. 7. 9	OCT 10 30	TO WAGES, WEEK TO 11TH OCTOBER EAST BRANCH	5	2820	4. 2. 6	—	312.10. 3	308. 7. 9	4. 2. 6 ....
312.10. 3	OCT 10 30	WEST BRANCH		2822	2.13. 0		315. 3. 3	312.10. 3	2.13. 0 ....
315. 3. 3	OCT 10 30	NORTH BRANCH		2824	4.13. 3		319.16. 6	315. 3. 3	4.13. 3 ....
					622.18. 9				622.18. 9
90655. 9.11	OCT 10 30	TOTAL PAYMENTS	45		622.18. 9		91278. 8. 8	90655. 9.11	622.18. 9 ....
168.19. 9	OCT 10 30	BY THOMAS BOYD, 1WEL BLOOD, 17TH JUNE	6	2908		6. 0. 0	174.19. 9cr....	168.19. 9	6. 0. 0 ....
347814. 8. 8	OCT 10 30	BY MORTGAGES, 123/456 J. SMITH	7	2869		500. 0. 0	348314. 8. 8cr....	347814. 8. 8	500. 0. 0 ....
348314. 8. 8	OCT 10 30	789/123 ALEX. LEITCH		2976		3000. 0. 0	351314. 8. 8cr....	348314. 8. 8	3000. 0. 0 ....
87.10. 2	OCT 10 30	BY CONTRIBUTIONS, WEEK TO 8TH OCTOBER WATCHMEN, CITY CHAMBERS	8	2896		6. 7	87.16. 9cr....	87.10. 2	6. 7 ....
87.16. 9	OCT 10 30	CARETAKER, COLLECTOR'S DEPT.	8	2897		2. 2	87.18.11cr....	87.16. 9	2. 2 ....
420. 3. 9	OCT 10 30	BY DUES, WAVERLEY MARKET, WEEK TO 8TH OCT.	9	2864		4.15. 4	424.19. 1cr....	420. 3. 9	4.15. 4 ....
1083. 5. 0	OCT 10 30	BY JOHN FORBES, 2ND MOIETY OF RENT, ALBERT HALL, BAND CONTEST, 11TH OCT.	10	2886		15. 0. 0	1098. 5. 0cr....	1083. 5. 0	15. 0. 0 ....
						3526. 4. 1			3526. 4. 1
91278. 8. 8	OCT 10 30	TOTAL RECEIPTS	45			3526. 4. 1	87752. 4. 7	91278. 8. 8	3526. 4. 1 ....

City and Royal Burgh of Edinburgh
General Ledger – Year 1930-31.

Folio 45/5.

Account: COMMON GOOD
Head of Account: SLAUGHTERHOUSES.
Sub Head of Account: SALARIES, WAGES AND ALLOWANCES.
Estimate Limit

Date	Narrative	Ledger Folio	Voucher No.	Payments	Receipts	Balance
OCT 10 30	BALANCE BROUGHT FORWARD				—	308. 7. 9 ....
OCT 10 30	TO WAGES, WEEK TO 11TH OCTOBER EAST BRANCH	5	2820	4. 2. 6		312.10. 3 ....
OCT 10 30	WEST BRANCH		2822	2.13. 0		315. 3. 3 ....
OCT 10 30	NORTH BRANCH		2824	4.13. 3		319.16. 6 ....

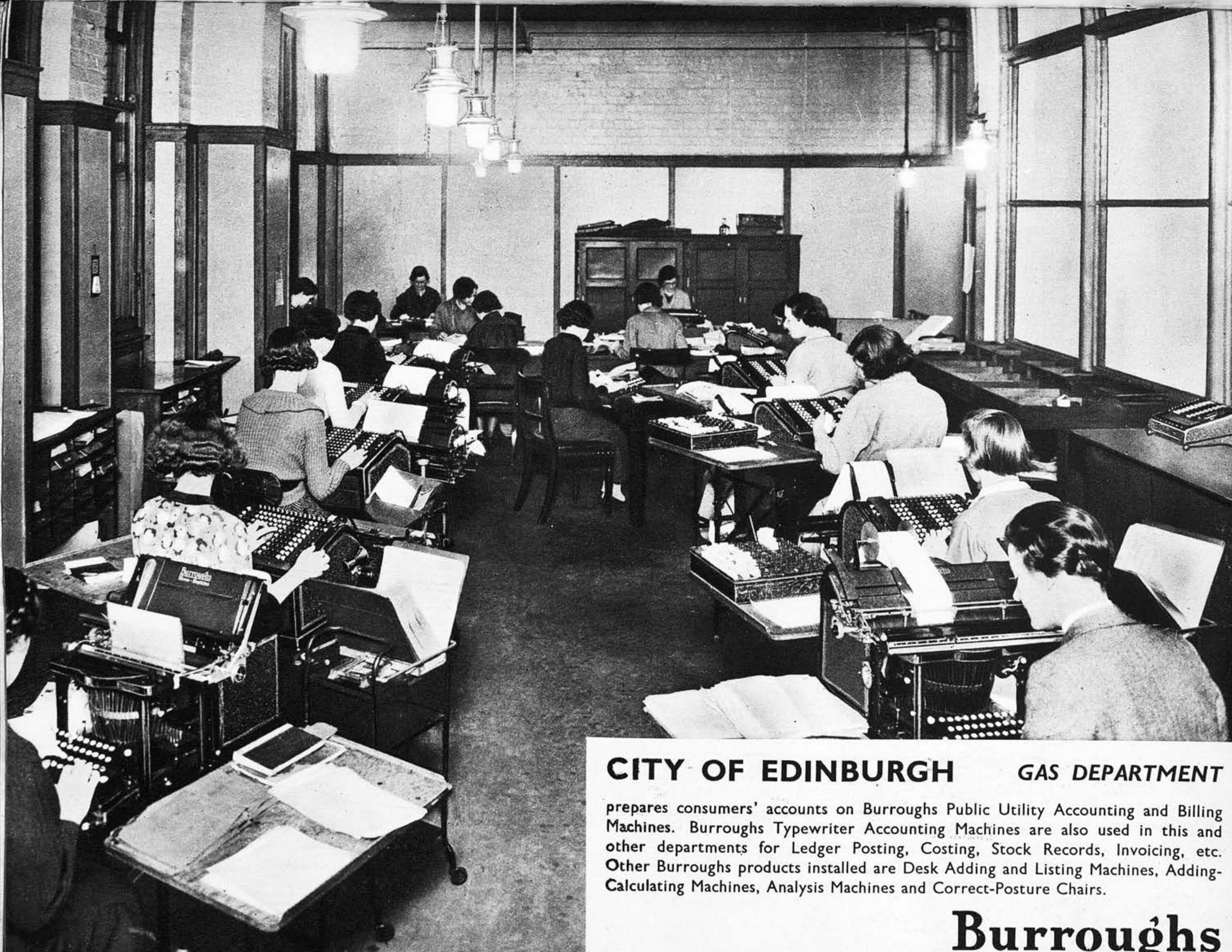
City and Royal Burgh of Edinburgh
General Ledger – Year 1930-31.

Folio 45.

Account: COMMON GOOD
Head of Account: CONTROL
Sub Head of Account:
Estimate Limit

Date	Narrative	Ledger Folio	Voucher No.	Payments	Receipts	Balance
	BALANCE BROUGHT FORWARD					90655. 9.11 ....
OCT 10 30	TOTAL PAYMENTS	45		622.18. 9		91278. 8. 8 ....
OCT 10 30	TOTAL RECEIPTS	45			3526. 4. 1	87752. 4. 7 ....

No. 1029



CITY OF EDINBURGH   *GAS DEPARTMENT*

prepares consumers' accounts on Burroughs Public Utility Accounting and Billing Machines. Burroughs Typewriter Accounting Machines are also used in this and other departments for Ledger Posting, Costing, Stock Records, Invoicing, etc. Other Burroughs products installed are Desk Adding and Listing Machines, Adding-Calculating Machines, Analysis Machines and Correct-Posture Chairs.

Burroughs

CITY OF EDINBURGH

ELECTRICITY DEPARTMENT

prepares consumers' accounts on Burroughs Public Utility Accounting and Billing Machines. Burroughs Typewriter Accounting Machines are also used in this and other departments for payroll, costing, etc. Other Burroughs products installed are Accounting Machine for stock records, Adding-Calculating Machine, Analysis Machine and Correct-Posture Chairs.

Burroughs

THE LEEDS CASE

The recent case (1938) of office mechanisation in Leeds whereby the Corporation of that city was involved in a loss variously estimated as between £25,000 and £30,000, affords a striking illustration of the temporary failure of a sound mechanical system when associated with circumstances not adequately conditioned to the extensive application of such methods.

It is understood that the application of the machinery was conjoined to composite accounts embracing rates, gas, water and electricity charges, while the arrangements for the synchronising of the appropriate charges for the various services were not perfected. In consequence, there were considerable difficulties in getting each composite account timeously completed and issued, resulting in a marked growth in the sundry debtors. The practical difficulties of operating combined accounts without combined meter reading are well known from experience in Edinburgh in 1926-27.

The following statistics appearing in the Leeds accounts may be noted:-

	Rates	Electricity	Gas	Transport	Water
Sundry Debtors (Revenue)					
1935	316,153	341,721	149,784	9,306	47,539
1936	464,427	348,123	164,720	5,955	48,929
1937	358,008	348,868	182,134	6,737	53,721
1938	374,642	590,449	268,291	7,411	130,907